

2. DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

DOE proposes to construct, operate, and decontaminate and decommission (D&D) a waste treatment facility for the treatment of legacy ORNL TRU, alpha low-level waste, and newly generated TRU waste (Figure 2-1) in order to reduce the risk to human health and the environment, and to comply with the TDEC Commissioner's Order of 1995, which has a primary milestone that requires DOE to make the first shipment of treated TRU sludge to the Waste Isolation Pilot Plant in New Mexico by January 2003. Impacts relative to the construction, operation, and D&D¹ of any treatment facility are presented in Chapter 4, in detail, for each treatment alternative evaluated in this EIS. All the legacy waste DOE proposes to treat as part of the TRU Waste Treatment Facility Project is currently stored at ORNL. The newly generated TRU waste would be treated at the proposed facility until it is closed for D&D. TRU waste generated after closure of the proposed facility is not within the scope of the proposed action.

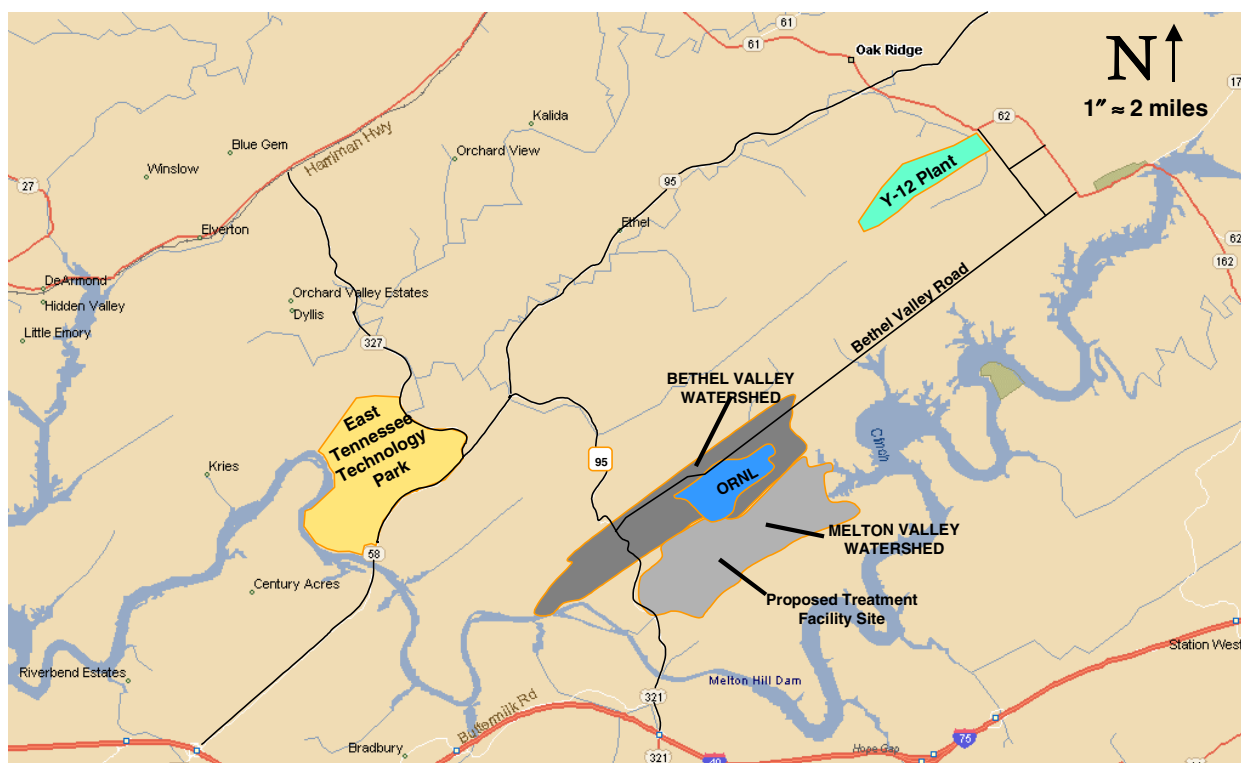


Figure 2-1. General site location of the proposed TRU Waste Treatment Facility at Oak Ridge National Laboratory (ORNL) on the Oak Ridge Reservation (ORR).

DOE's proposed action would entail the award of a privatization contract, contingent upon the completion of the NEPA review, for the construction, operation, and D&D of the proposed waste treatment facility to a private contractor. DOE solicited bids from contractors for a treatment facility for the TRU wastes. The privatization contract request for proposal was structured so that the selected

¹Specific information on impacts resulting from D&D activities can be found in Chapter 4 in Sections 4.1.3, 4.1.4, 4.1.5, 4.1.6, 4.3.7, 4.4.3, 4.4.5, 4.4.7, 4.5.2, 4.5.3, 4.7.3, 4.7.5, 4.7.6, 4.7.7, 4.8.3, 4.8.4, 4.8.5, 4.8.6, and 4.10.5.

contractor would be required to use its own funds for the construction of the facility, and so that payment for the construction portion of the contract would not be made until the waste was treated to meet the appropriate waste acceptance criteria and certified by DOE. Three bids were received and evaluated. DOE incorporated environmental information very early in the project planning. For example, DOE required proposals to include environmental data and analysis. Prior to selection of the contractor, DOE held two public meetings with stakeholders and had ongoing discussions with regulators. In addition, DOE prepared a characterization report for the site of the proposed action and sponsored an independent study of treatment technologies and contracting alternatives, known as the Parallax study [ORNL/M-4693, *Feasibility Study for Treatment ORNL TRU Waste In Existing and Modified Facilities*, September 15, 1995 (Parallax 1995)]. DOE independently evaluated the environmental information provided in the bids. DOE developed an environmental synopsis of the environmental information in accordance with 10 CFR 1021.216 and published the *Environmental Synopsis for the Transuranic Waste Treatment Project at the Oak Ridge Reservation* in January 1999 (Appendix A.2). This synopsis has been filed with the EPA and made available to the public.

The proposed site for the treatment facility is adjacent to the Melton Valley Storage Tanks (the current storage area for the waste sludge and supernate). DOE would lease the Melton Valley Storage Tanks and an adjacent land area totaling up to 4 ha (10 acres) to the selected contractor for the construction of the facility (Figure 2-2), subject to notification of the EPA and the State of Tennessee to clarify the change in land use. Once the facility is closed and D&D of the facility is completed, the Melton Valley Storage Tanks and the land used for the facility would no longer be leased to the selected contractor.



Figure 2-2. DOE would lease the Melton Valley Storage Tanks facility and an adjacent area of land to construct the waste treatment facility. The location is isolated from ORNL by Haw Ridge.

The proposed facility location is based on two factors listed below:

- The treatment facility should be located close to the existing Melton Valley Storage Tanks to minimize the length of a new sludge/supernate transfer line and reduce the environmental disturbance due to construction as recommended in the *Feasibility Study for Processing ORNL Transuranic Waste in Existing and Modified Facilities* (Parallax 1995).
- The existing terrain should provide natural shielding for the proposed facility and facilitate material handling.

The location of the proposed facility near the Melton Valley Storage Tanks would reduce the risk associated with transporting the liquid and sludge tank waste from the Melton Valley Storage Tanks to the proposed treatment facility over public or laboratory roads. The Melton Valley Storage Tanks are located in Melton Valley, separated from the main plant area at ORNL by the Haw Ridge. The proposed treatment facility site would be fenced, with controlled access to Tennessee State Highway 95, which is located west of the proposed site. DOE would provide electrical, water, and telephone service to the edge of the leased area on the east side of the facility. DOE upgraded the existing single-lane road (Old Melton Valley Road, referred to as High Flux Isotope Reactor access road by some sources) from State Route 95 to the proposed facility to provide improved emergency access from the High Flux Isotope Reactor. This road will become the main access to the proposed facility. A categorical exclusion under NEPA was executed for this road upgrade (CX-TRU-98-007, *Categorical Exclusion for Construction/Relocation of Access Road at Oak Ridge National Laboratory*) (DOE-ORO 1998). Because most of the sludge is regulated under RCRA, the proposed facility would be permitted under RCRA.

The proposed action would be carried out in four phases:

- Phase I, Licensing and Permitting [includes DOE's NEPA analysis and contractor preliminary design activities; U.S. Nuclear Regulatory Commission (NRC) license is not required as the facility will only be treating DOE wastes];
- Phase II, Construction and Pre-Operational Testing;
- Phase III, Waste Treatment, Packaging, and Certification; and
- Phase IV, Decontamination and Decommissioning.

DOE will complete the NEPA process concurrent with Phase I of the contract. Phase I is a 2.5-year period during which the permitting and preliminary design process is completed for the proposed facility. If the NEPA review results in another alternative being selected, the contract would be terminated before Phase II of the contract begins.

DOE requires that all activities associated with the proposed action be performed safely and in compliance with applicable federal and state regulatory requirements. The selected contractor would be responsible for achieving compliance with all applicable environmental, safety, and health laws and regulations. Regulatory agencies would be responsible for monitoring compliance by the contractor. The State of Tennessee would regulate the selected contractor according to permits under the state's purview (the RCRA Part B permit issued by the State of Tennessee). DOE would regulate occupational safety and health and nuclear safety according to specific environment, safety, and health requirements.

Waste volume reduction would be a major consideration for the proposed action. Waste volume reduction would minimize waste generation during the treatment process, conserve resources, and would

result in lower disposal costs. The waste treatment technique used in the proposed action would need to be flexible enough to address a wide range of waste properties, substantially reduce the TRU waste volume, and generate minimal secondary waste during treatment. After waste treatment, DOE would certify the waste for disposal as low-level radioactive waste, alpha low-level radioactive waste, or TRU waste. The contractor would be required to treat all wastes to meet specified waste acceptance criteria for disposal. In the event that the Waste Isolation Pilot Plant is not accepting remote-handled TRU waste in time to meet the TDEC Commissioner's Order, the selected contractor would be required to reduce the solubility of the RCRA metals in the sludge waste in order to form stable compounds. The stabilized sludge would not exceed the RCRA Toxicity Characteristic Leaching Procedure (TCLP) limits and would no longer exhibit RCRA characteristics. This would ensure that the treated waste meets RCRA Land Disposal Restriction (LDR) standards, required by the ORNL Site Treatment Plan, in the event that the treated waste is stored onsite before transport to the Waste Isolation Pilot Plant.

The proposed action calls for the segregation of the legacy sludge and supernate contained in the waste storage tanks. The segregation of these wastes would result in significant life cycle cost avoidance when compared to disposal of both the sludge and supernate at the Waste Isolation Pilot Plant. The supernate, which is generally classified as low-level waste, would be reduced in volume during waste treatment, and packaged for final disposal at the Nevada Test Site consistent with the *Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-level and Mixed Low-level Waste; Amendment of the Record of Decision for the Nevada Test Site* (DOE 2000).

Because most of the current solid waste containers do not meet DOT regulations, the proposed action would provide for repackaging the solid waste prior to shipment. The waste would be certified for disposal by DOE as either low-level radioactive, alpha low-level radioactive, or TRU waste and transported to appropriate disposal facilities that are consistent with the WM PEIS. The proposed action includes repackaging with some compaction to obtain a 50% volume reduction for the bulk of the solid waste that is not regulated under RCRA. The solid waste would be better characterized during the repackaging efforts to achieve final waste certification by DOE before disposal. Any items displaying RCRA characteristics would be isolated and treated to meet RCRA LDR standards.

2.2 CONSIDERATION OF ALTERNATIVES

DOE analyzed five alternatives in this EIS: a no action alternative; three alternative technologies for treating the legacy wastes followed by shipment to an appropriate disposal facility; and treatment by any of the three alternative treatment technologies, followed by interim storage at ORNL. Shipment of the TRU wastes to other DOE sites for treatment was also considered, but not analyzed in detail for reasons discussed in Section 2.8.1. Other potential treatment technologies were also evaluated, but were not analyzed in detail for various reasons (Table 2-5, Section 2.8.4).

A summary of the environmental impacts for the five alternatives is included in Section 2.9. The remainder of Chapter 2 discusses the following five alternatives in detail:

1. **No Action** (i.e., continued on-site storage and no waste treatment) for all of the legacy TRU tank waste stored in the Melton Valley Storage Tanks and the legacy contact-handled and remote-handled TRU/alpha low-level solid wastes stored in trenches, vaults, and metal buildings.
2. **Low-Temperature Drying (Preferred Alternative)** for the Melton Valley Storage Tanks wastes (sludge and supernate) and segregation and compaction for the solid wastes (contact-handled and remote-handled TRU/alpha low-level heterogeneous debris).
3. **Vitrification** for the Melton Valley Storage Tanks wastes (sludge and supernate) and segregation and compaction for the solid wastes (contact-handled and remote-handled TRU/alpha low-level heterogeneous debris).
4. **Cementation** for the Melton Valley Storage Tanks wastes (sludge and supernate) and segregation and compaction for the solid wastes (contact-handled and remote-handled TRU/alpha low-level heterogeneous debris).
5. **Treatment and Waste Storage at ORNL** would provide treatment by one of the above treatment alternatives followed by interim waste storage at ORNL.

2.3 NO ACTION ALTERNATIVE

Under the No Action Alternative, DOE would continue to store legacy TRU waste at ORNL in underground waste storage tanks, subsurface trenches, vaults, bunkers, and metal buildings. Long-term storage, consistent with the No Action Alternative, is not permissible under RCRA, which does not allow storage of untreated hazardous wastes indefinitely.

2.3.1 Facility Description

No facility would be constructed under the No Action Alternative for the treatment of legacy TRU waste. Existing facilities at ORNL would be used for the continued storage of the legacy TRU waste. Legacy mixed (RCRA hazardous and radioactive) TRU sludge and the associated low-level supernate wastes would continue to be stored in the Melton Valley Storage Tanks and the Melton Valley Storage Tanks–Capacity Increase Project tanks (Figure 2-2). There is slightly over 1,400 m³ (about 370,000 gal) of storage capacity available in the existing storage tanks.

Legacy solid remote-handled and contact-handled wastes would be stored in their current facilities described below.

- Solid Waste Storage Area 5 North (SWSA 5 North) is at capacity and stores remote-handled TRU solid wastes and TRU mixed wastes in casks buried underground in trenches.
- Buildings 7855 and 7883 are bunkers, which would continue to store remote-handled TRU waste. Building 7855 is at capacity, with 157.2 m³ (5,552 ft³) of remote-handled TRU waste in storage. Building 7883 currently stores 10.7 m³ (377 ft³) of remote-handled TRU solids and has an available storage capacity of 146.7 m³ (5,179 ft³).

- Buildings 7572, 7574, 7842, 7878, and 7879 are metal buildings that would continue to store contact-handled TRU waste. These storage buildings currently store over 906 m³ (32,000 ft³) of contact-handled TRU wastes. Building 7842 is at capacity, but the other buildings have a combined available storage capacity of 722 m³ about (25,500 ft³) for contact-handled TRU wastes.
- Buildings 7826 and 7834, the below-grade concrete cells in SWSA 5 North, which currently store a total of about 68 m³ (2,400 ft³) of remote-handled TRU and contact-handled waste, are not RCRA permitted. This waste is scheduled to be moved to the appropriate existing facilities for contact-handled and remote-handled wastes (described above) as a legacy waste action under CERCLA in FY 2000, thus reducing the amount of permitted storage space that is available.

2.3.2 Treatment Description

There would be no waste treatment under the No Action Alternative for TRU wastes.

2.3.2.1 Sludge and supernate

The No Action Alternative involves continued storage of legacy mixed (RCRA constituents and radioactive) TRU sludge and associated low-level supernate waste in the Melton Valley Storage Tanks at ORNL.² If this alternative were chosen, the Interim Record of Decision for the Gunit and Associated Tanks (DOE 1997a) and the Action Memorandum for the Old Hydrofracture Facility tanks (DOE 1997b) would require amendment since these documents indicated that the waste would be consolidated in the Melton Valley Storage Tanks in preparation of treatment prior to disposal at the Waste Isolation Pilot Plant. In addition, the continued storage of this waste onsite at ORNL would be in violation of DOE Order 435.1.

2.3.2.2 Remote-handled and contact-handled solid wastes

Remote-handled and contact-handled solid wastes would continue to be stored at ORNL in the existing solid waste storage facilities and in the SWSA 5 North trenches under the No Action Alternative.³ If this alternative were chosen, the Record of Decision for the Melton Valley Watershed (DOE 1997c) would have to be amended, since removal of the retrievable TRU waste in the SWSA 5 North trenches is a main component of the selected remedy for the Melton Valley Watershed.

²Basic research and environmental remediation activities at ORNL would continue to generate new waste at a rate of approximately 60 m³ (15,850 gal) of liquid low-level waste and 5 m³ (175 ft³) of TRU sludge annually. These wastes would be added to the legacy sludge and supernate to be treated in the proposed facility. After the proposed treatment facility is closed, newly generated waste would be stored in the Melton Valley Storage Tanks and Capacity Increase Project tanks, which have enough tank capacity for approximately 21 years. In the event that construction of any new waste storage tanks would be needed, these facilities would be evaluated in a separate NEPA review.

³There would be enough storage capacity for newly generated remote-handled TRU solid waste for approximately 14.5 years, assuming a generation rate of approximately 10 m³ (350 ft³) per year. There would be enough storage space for contact-handled TRU waste for approximately 100 years, assuming a generation rate of approximately 5 m³ (175 ft³) per year. In the event that construction of any additional storage facilities for newly generated remote-handled and contact-handled solid waste would be needed, these facilities would be evaluated under a separate NEPA review.

2.3.3 Schedule of Activities

For purposes of analyses, the No Action Alternative assumes institutional control of the waste identified for treatment under the proposed action in this EIS for 100 years, after which there would be a loss of institutional control.

2.4 LOW-TEMPERATURE DRYING ALTERNATIVE (PREFERRED ALTERNATIVE)

DOE has awarded a contract with the Foster Wheeler Environmental Corporation (Foster Wheeler) to construct a waste treatment facility and to treat and package the TRU wastes for disposal offsite. The contract with Foster Wheeler was awarded contingent on the completion of the NEPA review and selection of the Foster Wheeler proposed treatment process in the Record of Decision. DOE continues to analyze environmental impacts and evaluate alternative actions while Phase I (Licensing and Permitting) of the contract awarded to Foster Wheeler is under way. If the current NEPA review results in the selection of an alternative other than the preferred alternative, Phase II (construction and pre-operational testing) of the contract would not be executed.

Foster Wheeler proposes to use a low-temperature drying treatment for the tank waste, and sorting, compaction, and repackaging for the solid waste, before the waste is certified by DOE for final disposition. TRU waste would be disposed at the Waste Isolation Pilot Plant, consistent with the *Record of Decision for the Department of Energy's Waste Management Program: Treatment and Storage of Transuranic Waste* (DOE 1998b). Low-level waste would be disposed at the Nevada Test Site selected in the *Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-level and Mixed Low-level Waste; Amendment of the Record of Decision for the Nevada Test Site* (DOE 2000). The contract allows DOE and Foster Wheeler to identify other potential waste streams for treatment at this facility during Phase I of the contract and may include newly generated waste from the ORR, or small amounts of legacy TRU waste from other sites. Before any such waste streams would be considered or shipped to ORNL, they would be subject to further NEPA review, as appropriate.

2.4.1 Facility Description

The Low-Temperature Drying Alternative (Preferred Alternative) would involve the construction of a three-and-one-half-story waste treatment facility approximately 37 m (120 ft) west of the Melton Valley Storage Tanks area. The proposed site would encompass 2 ha (5 acres) of the approximately 4 ha (10 acres) that would be included in the lease.

The proposed waste treatment facility would have a partial floor for treatment of the supernate between the first and second floors. The facility would be a steel-framed structure with concrete and steel shielding. An attached steel building would house the administrative and personnel areas on the north side of the facility, and trailers for the nondestructive examination and assay of the contact-handled solid wastes would be located on the south side of the facility. The total floor area of the facility would be approximately 3,440 m² (37,000 ft²), comprised of an estimated 1,160 m² (12,500 ft²) of process area, 1,720 m² (18,500 ft²) of process support area, and 560 m² (6,000 ft²) of administration area.

The first floor would contain the remote-handled solid waste cask receiving and staging area as well as the treated solid waste cask and load-out area. Supernate treatment would be performed on the partial floor above the low-level waste load-out area. The dried supernate would be discharged by gravity to liners positioned on truck trailers for final packaging and shipping. The second floor would contain the contact-handled solid waste receiving and characterization area and the contact-handled and remote-handled solids treatment equipment. Facilities to support the building heating, ventilation, and air

conditioning (HVAC) and equipment maintenance activities would be located on the third floor. TRU sludge treatment equipment would be located on the fourth floor to receive and dry sludge that would be discharged to canisters located on the second floor. The facility ventilation exhaust stack would be located on the southeast corner of the building and would extend approximately 9 m (30 ft) above the highest point on the building. As shown in [Figure 2-3](#), the facility's first floor elevation would be approximately 235 m (770 ft) above mean sea level, which is above the 100- and 500-year flood elevations. Site development would require an approximate 6-m (20-ft) cut into the west ridge, with fill in the low areas around the facility and roadway areas. Detailed information about the proposed floor plans can be found in Appendix B.

Storm water drainage would be directed around the facility by a series of culverts and drainage ditches as shown in [Figure 2-3](#). This would prevent the facility from receiving storm water runoff from the ridgeline south of the facility. This runoff would be diverted west of the facility by a ditch along the third floor access ramp, and to the east by a berm and culvert arrangement. The drainage ditches would be lined with riprap, as required. Culverts carrying storm water off the facility site would be equipped with gate valves to allow sampling and analysis of the storm water and to provide storm water containment in case of potential contamination. Storm water collected from the top of the Melton Valley Storage Tank vaults would be controlled in a similar manner. In addition, drainage grates would be installed at paved exits to capture and direct runoff from paved areas to the culverts equipped with the gate valves.

2.4.2 Waste Treatment Description

This alternative would entail evaporating and drying the sludges and supernates and is flexible enough to cover a wide range of waste properties. Treatment by low-temperature drying would substantially reduce the waste volume, generate minimal amounts of secondary wastes, and meet the waste acceptance criteria of the final disposal facilities. All waste streams would meet the RCRA LDR standards. TRU waste streams would be treated to meet the waste acceptance criteria of the Waste Isolation Pilot Plant. Low-level waste streams would be treated to meet the waste acceptance criteria of the Nevada Test Site selected for low-level waste disposal in the *Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-level and Mixed Low-level Waste; Amendment of the Record of Decision for the Nevada Test Site* (DOE 2000). Several pollution prevention and waste minimization measures would be implemented with the Low-Temperature Drying Alternative. As pollution prevention measures, storm water would be diverted around the treatment facility and gate valves would be installed in the diversion basins to contain spills. Waste minimization is accomplished by the following methods:

- The Melton Valley Storage Tanks would be sluiced with recycled supernate during sludge retrieval activities.
- Sludge would be washed with recycled condensate from the air-cooled condenser, which receives the ventilation from the low-temperature dryers.
- Dried sludge solids would be loaded directly into TRU canisters to avoid additional secondary waste.
- Low-level solid waste drums that do not contain RCRA waste would be sent directly to the compactor for a 50% volume reduction.
- Secondary solid waste would be compacted for a 50% volume reduction.
- The off-gas system would minimize air emissions.

A summary of the projected volumes of primary, secondary, and D&D waste is included in [Table 2-1](#). The primary waste volumes would be reduced by low-temperature drying from 4,050 m³ to 1,391 m³.

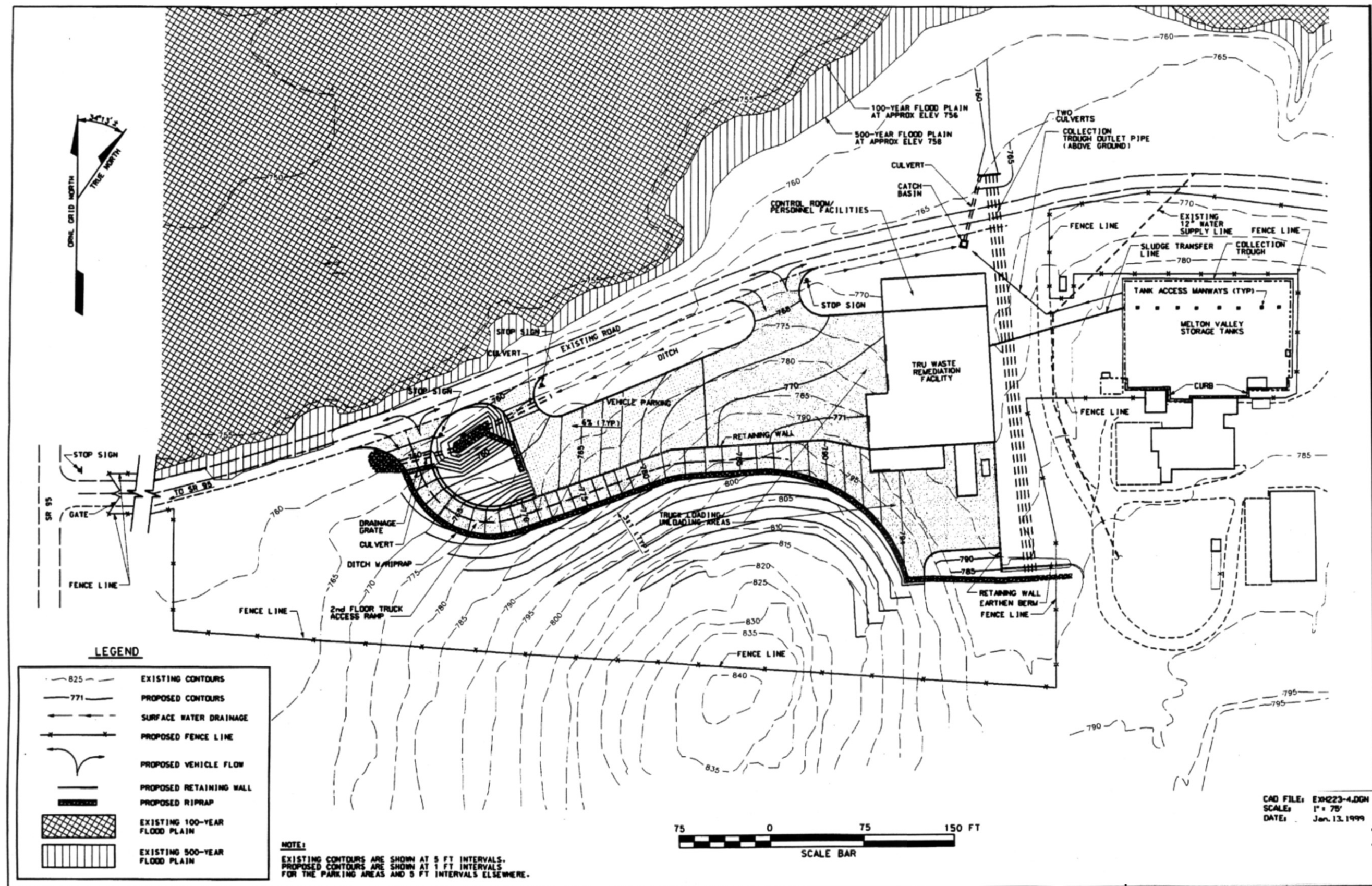


Figure 2-3. Proposed site layout for the Low-Temperature Drying Alternative facility, including the locations of the existing Melton Valley Storage Tanks, the process building with truck access and turnaround areas to the first and third floors, and storm water drainage modifications. Site excavation would be minimized by optimizing the topography of the site with the layout of the Low-Temperature Drying Alternative

Table 2-1. Summary of projected waste volumes for the Low-Temperature Drying Alternative

Waste Stream	Category	Projected Volume Out ^a	Treatment Requirement
<i>Primary Waste Streams</i>			
Sludge (remote-handled)	TRU	180 m ³	Dry, stabilize
Supernate/sludge wash water	Low-level waste	588 m ³	Dry, stabilize
Contact-handled solids	TRU	324 m ³	Various
Remote-handled solids	TRU	99 m ³	Various
Solids	Low-level waste	200 m ³	Various
<i>Secondary Waste Streams</i>			
Primary waste containers			
Remote-handled casks	Low-level waste	1,217 m ³	None
Contact-handled drums and boxes	Low-level waste	44 m ³	Compaction
Construction debris	Sanitary	~200 m ³	None
PPE (gloves, booties, etc.)	Low-level waste	214 m ³	Compaction
HEPA filters	Low-level waste	88 m ³	Compaction
Consumables (rags, towels, etc.)	Low-level waste	272 m ³	Compaction
Mechanical parts	Low-level waste/TRU	4 m ³	None
Aqueous waste filter media	Low-level waste	<20 m ³	Compaction
Steam from wet treatment	N/A	N/A	Condense/HEPA filter
Changing/maintenance fluids	Low-level waste/mixed waste	<1 m ³	Stabilize, if required
Laboratory solvents and residues	Low-level waste/mixed waste/TRU	1 m ³	Thermal, none
Laboratory acid digistatis	Mixed waste	<20 m ³	Neutralize/stabilize
Sanitary wastewater	Sanitary	1,560 m ³	Capture
<i>Decontamination and Decommissioning Waste Streams</i>			
Category C, Concrete rubble	Construction debris	5,510 m ³	None
Category A, Free release metals	Recycle, reuse	115 m ³	None
Category B, Non-contaminated metals	Construction debris	30 m ³	None
Category B, Contaminated materials	Low-level waste	135 m ³	Compaction
Category D, Miscellaneous	Construction debris	<10 m ³	None
Category E, Special materials	Low-level waste/mixed waste	<1 m ³	Stabilize

^aVolumes are waste product volumes in final disposal containers based on total inventory of waste (base + optional volumes) expected to be processed at the facility.

HEPA - High-Efficiency Particulate Air.

PPE - personal protective equipment.

TRU - transuranic.

~ - approximately.

2.4.2.1 Tank waste treatment (sludge and supernate)

The simplified block flow diagram for the tank waste treatment systems is illustrated in [Figure 2-4](#). Supernate would be pumped from the existing Melton Valley Storage Tanks using equipment moved from tank to tank. The supernate would be pumped through a double-contained, aboveground pipeline to the proposed treatment facility and collected into mixing/sample tanks. The supernate from the Melton Valley Storage Tanks may be transferred to an evaporator for volume reduction before transfer to the mixing/sample tanks. In order to meet RCRA LDR standards and waste acceptance criteria for the Nevada Test Site, additives would be mixed with the supernate in these tanks, as required for the downstream treatment operations. The supernate dryer would receive feed batches. The treated waste would be loaded directly into a disposal container that is pre-loaded in a transportation

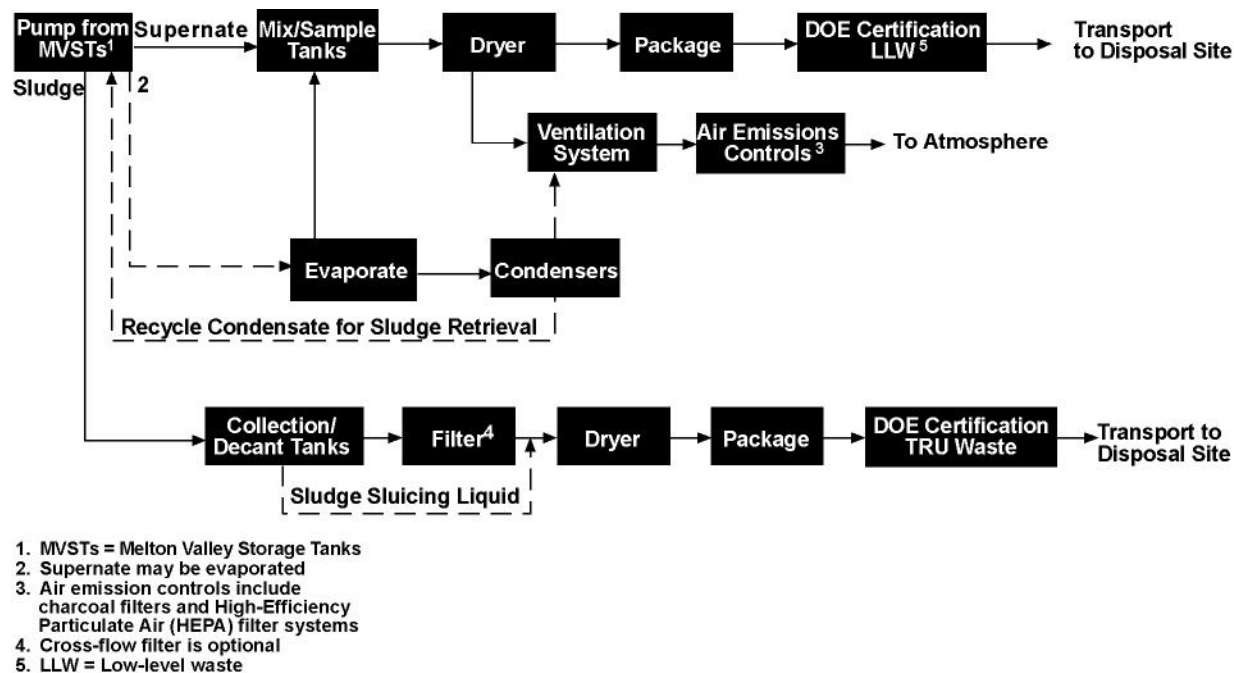


Figure 2-4. Tank waste treatment flow diagram for the Low-Temperature Drying Alternative.

cask for shipment. Vapors from the dryer would be routed through an air-cooled condenser. Condensate may be stored in a reservoir for reuse in sludge retrieval, or evaporated and discharged as part of the building ventilation flow through appropriate high-efficiency particulate air (HEPA) filtration.

Sludge would be retrieved from the Melton Valley Storage Tanks by sluicing with recycled liquids (supernate or condensate) or water. Recycled condensate or water would be preferentially used to allow washing of the sludge solids to separate soluble solids. The sluiced sludge would be transferred in a double-contained, aboveground pipeline to the sludge collection/decant tanks in the facility. These tanks would have the potential for concentrating the sludge by gravity settling. Sluiced sludge would be analyzed, mixed with appropriate additives, and concentrated for drying.

After analysis, the concentrated sludge/additive mixture would be transferred in batches to the sludge dryer. The sludge drying system would function in a similar fashion to the supernate dryer. For optimum efficiency, the dried sludge solids would be loaded directly into Waste Isolation Pilot Plant TRU canisters. Sludge distillate may be condensed or directed to the supernate treatment system.

2.4.2.2 Solid waste treatment (remote-handled and contact-handled solids)

DOE would deliver drums and boxes of the contact-handled solid waste to the proposed treatment facility. Foster Wheeler would perform visual inspections and radiation and contamination surveys prior to acceptance of the waste containers. The drum contents would be characterized by performing a non-destructive examination and assay in an adjoining enclosure before transfer to a staging area. The low-level waste drums that do not contain RCRA waste would be treated in a drum compactor for a 50% volume reduction, overpacked, weighed, and conveyed back to the shipping/receiving area for final

certification by DOE. The simplified block flow diagram for the tank waste treatment systems is illustrated in Figure 2-5.

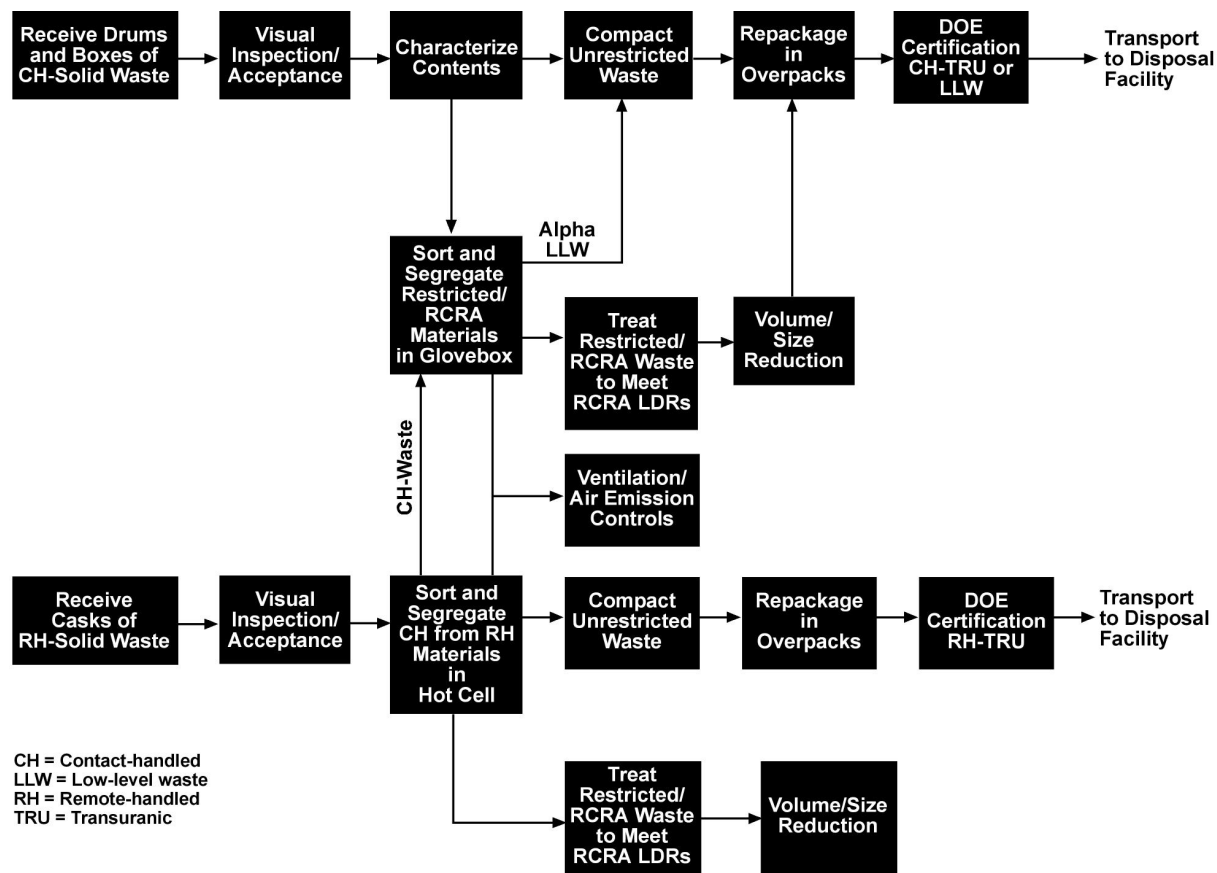


Figure 2-5. Solid waste treatment flow diagram for the Low-Temperature Drying Alternative.

The remaining drums would be transported to the process line area. The drums would be moved into a glovebox, opened, and the contents would be tipped onto a sorting tray where restricted/RCRA waste materials would be segregated manually via glove ports. The segregated low-level waste would be treated as described above. The RCRA/restricted waste materials would be treated by macroencapsulation or other techniques to meet RCRA LDR standards. Following treatment, the solid waste would be volume and size reduced. Depending on the TRU activity, the waste would be repackaged to meet the appropriate waste acceptance criteria, and certified for shipment by DOE.

Incoming boxes of waste would be moved into a glovebox. Waste would be removed from the boxes and placed on the sorting trays using waste removal tools attached to manipulators. RCRA/restricted waste would be segregated for handling in an adjacent treatment station. The remaining waste would be placed in drums and compacted “in-drum” prior to transfer back to the nondestructive examination and assay area for final certification by DOE and shipment to the Waste Isolation Pilot Plant. Secondary waste, such as empty waste containers, personal protective equipment, etc., would also be compacted prior to final certification by DOE and shipment offsite by the contractor to an appropriate disposal facility.

DOE would deliver the concrete casks containing remote-handled solid waste to the proposed waste treatment facility. Foster Wheeler would inspect and survey the waste upon receipt and then transfer the cask inside the facility. Treatment is initiated by raising the cask into a docking position with a hot cell to allow access to the cask lid from inside the hot cell. The contents of the cask would be removed using waste removal tools mounted on an overhead crane. Any oversized remote-handled TRU waste that is too large to fit into a canister would be size reduced. Waste would be placed in trays and conveyed through a nondestructive examination and assay station. A local gamma detector would identify any contact-handled waste, which would be routed directly to the contact-handled solids treatment glove box for treatment as discussed above. Waste that is compliant with LDR standards would be compacted and loaded into canisters docked at the load-out port on the hot cell. Higher activity low-level waste segregated in the sorting operation would be loaded into shielded drums at a separate load-out port for waste certification by DOE. Waste that does not meet RCRA LDR standards will be treated via macroencapsulation or other methods to meet RCRA LDR standards in the event that unanticipated storage is required. Macroencapsulation refers to a process where waste materials are embedded in an inert material.

2.4.3 Schedule of Activities

The total duration of the Low-Temperature Drying Alternative would be approximately 11.5 years, with less than 5 years of waste treatment, during which off-site shipments of treated waste to the appropriate disposal facility would occur. The proposed waste treatment schedule minimizes environmental impacts by combining the tank and solid waste treatment timelines, thus optimizing the sorting and segregation of TRU wastes for shipment to the Waste Isolation Pilot Plant and low-level waste for shipment to the Nevada Test Site. The schedule is designed to enable shipments to be certified by DOE for acceptance at the designated disposal facility within a reasonable time frame. It also allows the reduction in peak personnel loading and related personnel support facilities. The Low-Temperature Drying Alternative would consist of four phases. The four phases are depicted in [Figure 2-6](#), with further schedule detail provided in [Figure 2-7](#) for the treatment of the tank wastes and solid wastes, during which time off-site shipment of treated waste would occur.

Low-Temperature Drying Alternative

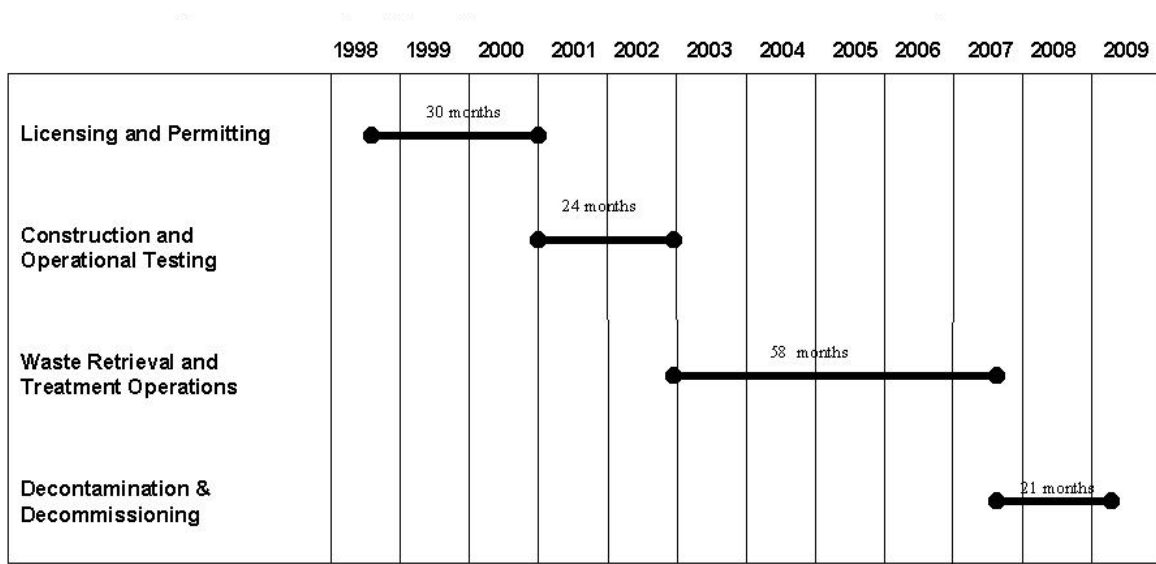


Figure 2-6. The Low-Temperature Drying Alternative would take place over a period of approximately 11.5 years.

Low-Temperature Drying Alternative Waste Treatment Schedule

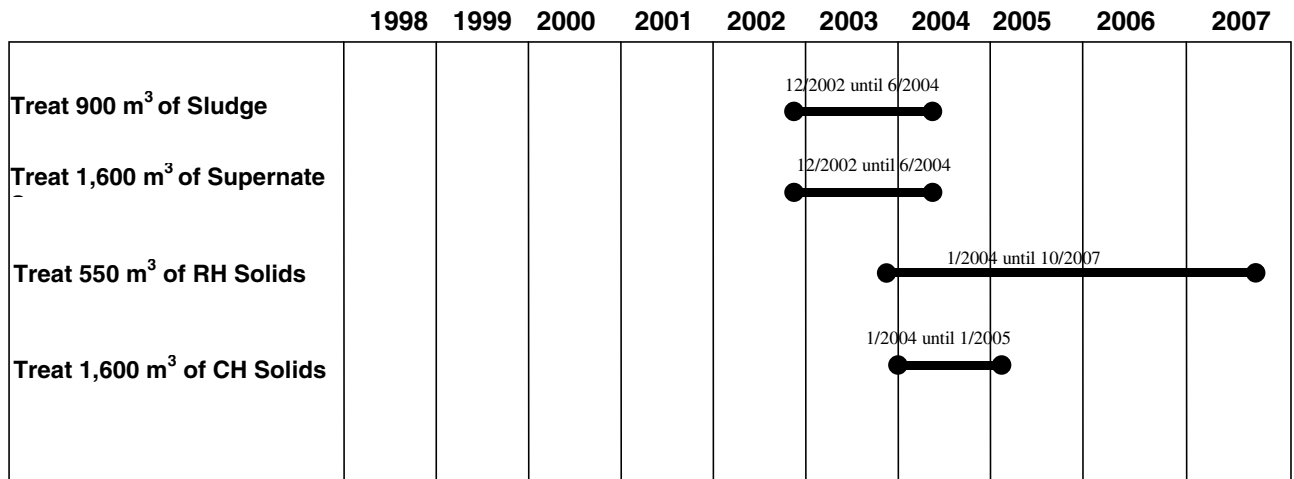


Figure 2-7. Waste treatment would be completed in approximately 5 years utilizing the Low-Temperature Drying Alternative.

2.5 VITRIFICATION ALTERNATIVE

The Vitrification Alternative would convert the sludge and supernate waste into a stabilized glass form, and segregate and super-compact the solid contact-handled TRU and remote-handled TRU solid wastes.

2.5.1 Facility Description

The facility for the Vitrification Alternative would be located on 2 to 2.8 ha (5 to 7 acres) west of the Melton Valley Storage Tank facility as indicated in the Proposed Action. The vitrification facility would be a three-and-one-half-story, steel-framed structure measuring 46 m × 76 m × 14 m (150 ft × 250 ft × 45 ft) with concrete and steel shielding. The total floor area would be approximately 7,400 m² (80,000 ft²), with an estimated 2,800 m² (30,000 ft²) for the process area and 4,600 m² (50,000 ft²) for the process support area. Doublewide trailers would be brought onsite to provide a detached administration area of approximately 740 m² (8,000 ft²).

2.5.2 Waste Treatment Description

The waste treatment for the Vitrification Alternative consists of sorting, compaction, grouting, and vitrification (changing the waste to a stable glass form by melting) to treat the waste ([Figure 2-8](#)). The vitrification system would treat liquids, soils, sludges, and other materials that are smaller than the RCRA definition of debris. A first-pass material balance for the vitrification treatment of remote handled TRU sludges, a material balance for the contact-handled TRU solid waste, and three material balances for the remote-handled TRU solid waste are presented in Appendix B, in the section covering Vitrification Alternative details. Assumptions used to develop these material balances and to determine a final stabilized waste form were based on information about the vitrification facilities at West Valley, New York, and Hanford, Washington, and the Melton Valley Storage Tanks treatability studies (Spence and Gilliam 1998). The assumptions also considered the characteristics of the existing waste. The Vitrification Alternative would implement several pollution prevention and waste minimization measures. As pollution prevention measures, storm water would be diverted around the facility and gate valves would be installed in the diversion basins to contain spills. Waste minimization would be accomplished by the following methods:

- Tank supernate would be used as the mixing media for sludge retrieval in the Melton Valley Storage Tanks.
- A cold cap would be maintained on the molten glass in the melter to minimize the loss of volatile organics to the atmosphere. A cold cap is molten glass that has cooled to form an impermeable layer (i.e., solid glass layer) on top of the molten glass.
- The solid waste drums would go through an initial characterization process. Drums not needing sorting and repackaging would be sent directly to the super-compactor for a 50% to 80% volume reduction.
- The off-gas system would minimize air emissions.

A summary of volumes of primary, secondary, and D&D waste streams are included in [Table 2-2](#).

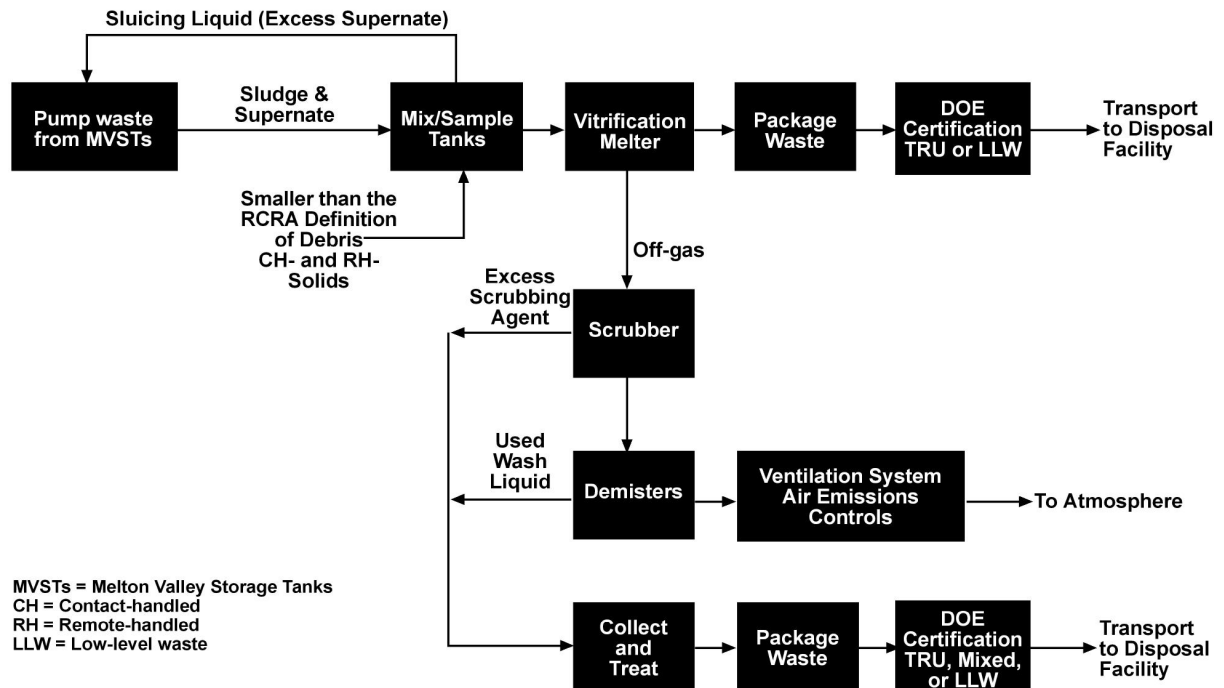


Figure 2-8. Treatment flow diagram for sludge, supernate, and solid waste smaller than the RCRA definition of debris for the Vitrification Alternative.

Table 2-2. Summary of projected waste volumes for the Vitrification Alternative

Waste Stream	Category	Projected Volume Out ^a	Treatment Requirement
<i>Primary Waste Streams</i>			
Sludge/Supernate	TRU	577 m ³	Vitrification
Contact-handled solids	TRU	260 m ³	Various
Remote-handled solids	TRU	116 m ³	Various
Remote-handled solids	Low-level waste	87 m ³	Various
<i>Secondary Waste Streams</i>			
Primary waste containers			
Remote-handled casks	Low-level waste	946 m ³	Volume reduction
Contact-handled drums and boxes	Low-level waste	44 m ³	Volume reduction
Construction debris	Sanitary	200 m ³	None
PPE (gloves, booties, etc.) ^b	Low-level waste	315 m ³	Volume reduction
HEPA filters ^b	Low-level waste	82 m ³	Volume reduction
Consumables (rags, towels, etc.) ^b	Low-level waste	181 m ³	Volume reduction
Mechanical/maintenance items	Low-level waste/TRU	97 m ³	Volume reduction
Industrial waste water	Low-level waste/sanitary	1,108 m ³	Capture
Evaporator concentrate	Low-level waste	326 m ³	Cementation
Laboratory solvents and residues	Low-level waste/mixed waste/TRU	2 m ³	Vitrification, stabilization
Sanitary solids	Sanitary	718 m ³	Capture
Sanitary wastewater	Sanitary	6,283 m ³	Capture
<i>Decontamination and Decommissioning Waste Streams</i>			
Concrete rubble	Construction debris	20,712 m ³	None
Free release metals	Recycle, reuse	120 m ³	None
Non-contaminated metals	Construction debris	48 m ³	None
Contaminated materials	Low-level waste	1,894 m ³	Volume reduction
Vitrified and residual material	TRU	10 m ³	None
Special materials	Low-level waste/mixed waste	2 m ³	Stabilize, special treatment

^aVolumes are waste product volumes in the final disposal containers.

^bIf the waste is determined to be hazardous, the waste would also be macroencapsulated

HEPA - High-Efficiency Particulate Air.

TRU - transuranic.

PPE - personal protective equipment.

2.5.2.1 Tank waste treatment (sludge and supernate)

Retrieved sludge and supernate from the Melton Valley Storage Tanks would remain commingled and then immobilized in a soda-lime-silica glass matrix to form a TRU waste product that meets both RCRA LDR standards and the Waste Isolation Pilot Plant waste acceptance criteria. In the Melton Valley Storage Tanks sludge treatability study (Spence and Gilliam 1998), tests were conducted on the Melton Valley Storage Tanks sludge using soda-lime-silica glass formers. The treated waste (i.e., glass sample - Melton Valley Storage Tank - V-18) had a specific gravity of 2.8, which indicated a waste loading (by mass) of 41%. The specific gravity helps to correlate the leachability of the waste and the stability of the waste form, and helps determine if the volume of treated waste is optimized. The sludge and supernate treatment process can be subdivided into four subsystems: the waste retrieval/receipt system, the melter feed preparation system, the melter system, and the off-gas treatment system.

Retrieved waste sludge and supernate would enter the treatment facility through the waste retrieval/receipt system (Figure 2-8). This system would provide buffer storage between the treatment facility and the waste retrieval system, and homogenize the sludge and supernate mixture for feed characterization (which will also determine the required glass former blend). Sludge and supernate retrieval operations would be conducted in the Melton Valley Storage Tanks using pulsed jet mixing, rather than sluicing, which would allow the existing supernate in the Melton Valley Storage Tanks to be used as the “mixing” media. Treating one tank at a time, the sludge would be mobilized and pumped to one of two sludge/supernate waste receipt tanks at the facility. Waste retrieval operations would be conducted only during day shifts with operations personnel stationed at a control module at the Melton Valley Storage Tanks and at the treatment facility control room.

The stainless steel waste receipt tanks would provide feed for 7 days of full operations for the melter system. This would minimize the impact on waste treatment due to downtime in the retrieval system, or hard-to-retrieve sludge. The waste receipt tank would be isolated from the retrieval system once it is filled. The second tank, if available, becomes the waste retrieval tank. A mechanical agitator would homogenize the waste to prevent solids from settling in the waste receipt tank. Homogenized waste would be sampled to determine the chemical and radiochemical composition for Waste Isolation Pilot Plant waste certification requirements, and to confirm that the treatment facility is meeting operational parameters. Once the analysis results confirm that the composition is acceptable, the waste receipt tank is considered part of the melter feed preparation system.

The melter feed operations include preparation of the dry glass-forming chemicals, mixing the dry chemicals with the homogenized waste stream, and feeding the resultant slurry to the melter. Glass-forming chemicals anticipated to be used for waste treatment include: soda (Na_2CO_3 - to get the alkali component: Na_2O), lime (CaO), and silica (SiO_2 - for glass forming). Alumina may also be used for glass forming. Based on the average concentrations and information provided from the treatability studies (Spence and Gilliam 1998), the glass former blend would be approximately 14.3% CaCO_3 , 41% dried waste, and 44.7% SiO_2 . Batches of waste and glass-forming compounds would be prepared for 24 hours of melter operations. The appropriate quantity of glass-forming components would be measured and fed into a hopper. An appropriate amount of homogenized waste would be transferred into a feed preparation tank along with the glass-forming chemicals from the hopper. Once the waste and dry chemicals are blended, a pump would transfer the blend to the melter feed tank. A mechanical agitator in the feed tank would keep the contents homogenous and to prevent solids settling.

The melter would have a throughput of 2 metric tons of glass per day and a minimum availability of 70%, equivalent to 260 operating days per year on a 7-day, around-the-clock basis. The glass product would occasionally be sampled to confirm that chemical composition is within the required range to produce acceptable quality glass. The melter would be a slurry-fed, joule-heated, ceramic unit, operating at a temperature of approximately $1,150^\circ\text{C}$ ($2,100^\circ\text{F}$). The melter would include a few safety features, such as a water-cooled refractory to contain the glass and a cold cap of unmelted glass floating on the glass surface. The cold cap helps minimize the loss of volatile chemicals to the off-gas system. Most of the feed components would be converted to their oxides, which dissolve in the molten glass. During the decomposition process, gases would be formed, heated, and released into the melter plenum and routed to the off-gas system. A fraction of the feed components would be directly carried over to the off-gas system without incorporation into the glass. However, some components would be volatile in the melter, and a significant fraction of these materials would be released to the off-gas system. The solids and semi-volatile components would be recycled back to the melter from the off-gas system to increase the incorporation rate for these components in the glass.

The major components of the off-gas resulting from the melter’s thermal processes would be nitrogen and oxygen due to air in-leakage to the melter and decomposition reactions occurring in the

melter. Other major components of the off-gas would be superheated steam from the evaporation of water, and NO_x from decomposition of metal nitrates. Chloride, fluoride, and SO_x would also be present due to feed decomposition, although in low concentrations compared to NO_x. The off-gas treatment system would exhaust gases from the melter plenum, maintain the melter at a negative pressure in relation to its cell, and clean the off-gas prior to stack discharge. The off-gas treatment system would consist of a primary system and a secondary system.

The primary off-gas treatment system would consist of three components: a film cooler, an off-gas quencher/scrubber, and a demister. This system would remove particulate carryover from the melter into the off-gas, the majority of radionuclides, a substantial amount of the acid gasses, and cool the off-gas prior to further treatment. The film cooler would cool the exiting off-gas to between 350 and 400°C (662 to 752°F) by injecting compressed air into the off-gas stream. The off-gas would then be drawn into an off-gas quencher/scrubber to further cool the off-gas. Hastelloy C or other similar metal alloys would be used for construction of the scrubber due to the high corrosion rate [> 0.05 in./year (Perry and Chilton 1973)] caused by the heat and high concentrations of halogen acid gases in the off-gas. The scrubbing agent could be water or slightly basic caustic. The scrubbing agent liquid would be collected and recycled back into the treatment process (as sluicing water that has better solubility capacity than supernate), or treated and disposed of as a secondary waste. Immediately downstream of the scrubber would be a pair of demisters. The demisters would remove mist and particulates from the off-gas stream, including the 90% or more of the remaining radionuclides in particulate form. The demisters would be washed regularly to prevent damaging downstream equipment such as pumps. Used demister wash liquid would be collected in a sump and recycled to help mobilize the sludge, or reprocessed.

The secondary off-gas treatment system performs final particulate filtration prior to stack discharge and consists of four HEPA filters in parallel sets of two. Each HEPA filter removes up to 99.95% of the remaining particulates in the off-gas stream. Gases (primarily air) leaving the HEPA filters are directed to the off-gas stack. Previous vitrification analysis conducted at DOE's Hanford site indicates that approximately 40% of the nitrate feed would be converted to nitrogen by the melter. Thus, it is possible that emissions from this treatment method would be below the Tennessee permit exemption levels without additional off-gas treatment systems.

2.5.2.2 Solid waste treatment (remote-handled and contact-handled solids)

In general, the remote-handled and contact-handled solid wastes would be sorted, treated, repackaged, compacted, overpacked, grouted, certified by DOE, and packed in appropriate transport containers. Certified TRU waste would be disposed at the Waste Isolation Pilot Plant, and low-level waste would be disposed at the Nevada Test Site selected in the *Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-level and Mixed Low-level Waste; Amendment of the Record of Decision for the Nevada Test Site* (DOE 2000). A small amount of the contact-handled and remote-handled solid wastes would be treated by vitrification if their size is smaller than what RCRA defines as debris. Mixed wastes that are primarily solids with RCRA metal constituents are expected to meet the definition of debris and would be macroencapsulated (embedded in an inert material) per the alternative treatment standards found in 40 *CFR* 268.45, Table 1. The treated waste would meet RCRA LDR standards in the event that unanticipated storage is required onsite. Materials not considered debris would be segregated and treated at the facility to allow disposal.

The solid waste treatment train would be remotely operated, and primary subsystems include solid waste receipt, the solid waste pretreatment system, the compaction and repackaging systems, and the macroencapsulation system (Figure 2-9). Solid waste containers would be unloaded in the solid waste receipt area and monitored for surface radiation dose level and contamination. Remote-handled solid waste would not be received until all of the contact-handled solid waste is processed. The wastes would

be brought to the second floor bay area. This buffer storage area would remain at a minimal level (approximately one full week of treatment).

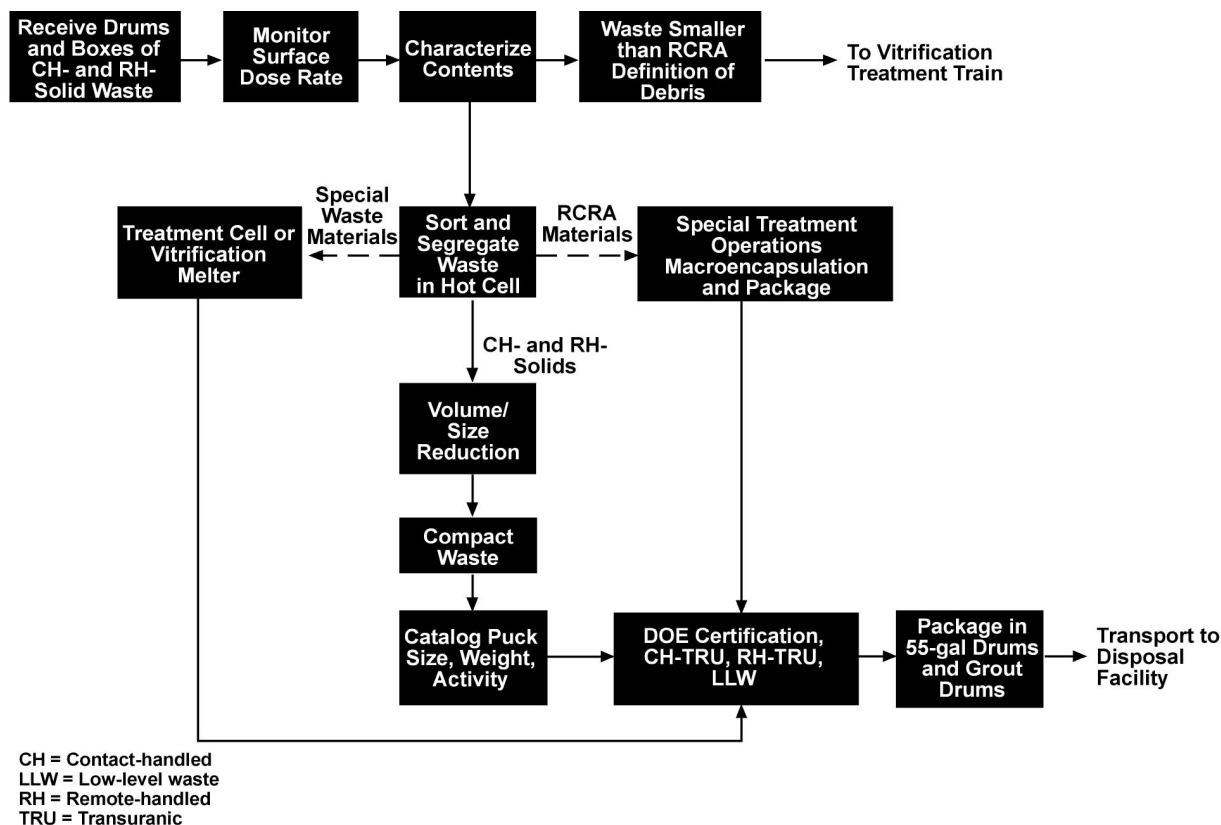


Figure 2-9. Vitrification Alternative flow diagram for solid waste treatment.

Solid waste would be characterized by nondestructive examination and assay methods, such as High Resolution Gamma Spectroscopy and passive and active neutron analysis, to determine the fissile content. Some containers may not require repackaging if their contents are confirmed as debris by real-time radiography. All other waste containers would be transferred to the hot cell for characterization. Solid wastes that may contain hazardous constituents, such as lead and mercury, would be treated in the Special Treatment Operations area. Special waste material such as batteries, aerosols, and gas bottles, would be sorted from the debris waste, collected, and sent to a special treatment cell, or some other applicable treatment facility. The sorting would be done with a remote manipulator; however, if dose limits are sufficiently low (e.g., less than 10 mrem/hour), some of the wastes contained in 30- and 55-gal drums may be sorted by hand. Some material (e.g., metal) may be resized in order to maximize the waste volume in a sorted container. Sorted waste containers would be sent to the supercompactor.

Drums of repackaged contact-handled and remote-handled solid wastes would be characterized and weighed before compaction to provide the information for DOE waste certification. The compacted repackaged waste would be in the form of a puck between one-half to one-fifth of the height of the original container. Waste pucks would be cataloged for size, weight, and activity and then placed in 55-gal drums in such a manner to ensure full encapsulation by the grout (the assumed macroencapsulating

material). Grout would be metered to ensure encapsulation around the pucks. The grouted overpack container would be placed into the buffer storage area until the grout has set.

2.5.3 Schedule of Activities

The total project duration of the Vitrification Alternative would be approximately 10 years, with about 3 years of waste treatment, during which offsite shipments of treated waste to the appropriate disposal facility would occur. Following 3 months of cold commissioning after construction of the facility, hot operations would be conducted for a period of 2.75 years. This treatment schedule combines the tank and solid waste treatment timelines and adjusts shift requirements to balance the life cycle of operations while minimizing duplication of treatment unit operations and treatment equipment. This approach would allow for reduction in peak personnel loading (except during construction activities) and related personnel support facilities. Contact-handled solids would be treated first and would normally proceed at a rate of approximately 13 drum equivalents per day on a 2-shift, 5-day basis. The remote-handled solids treatment would proceed at a rate of approximately 0.7 casks per shift on a 2-shift, 5-day basis. Contact-handled solid waste treatment would require approximately 1.25 years of operations, and remote-handled solid waste treatment would require 1.5 years. The overall project schedule is depicted in [Figure 2-10](#), and details of the waste treatment schedule are provided in [Figure 2-11](#).

Vitrification Alternative Schedule

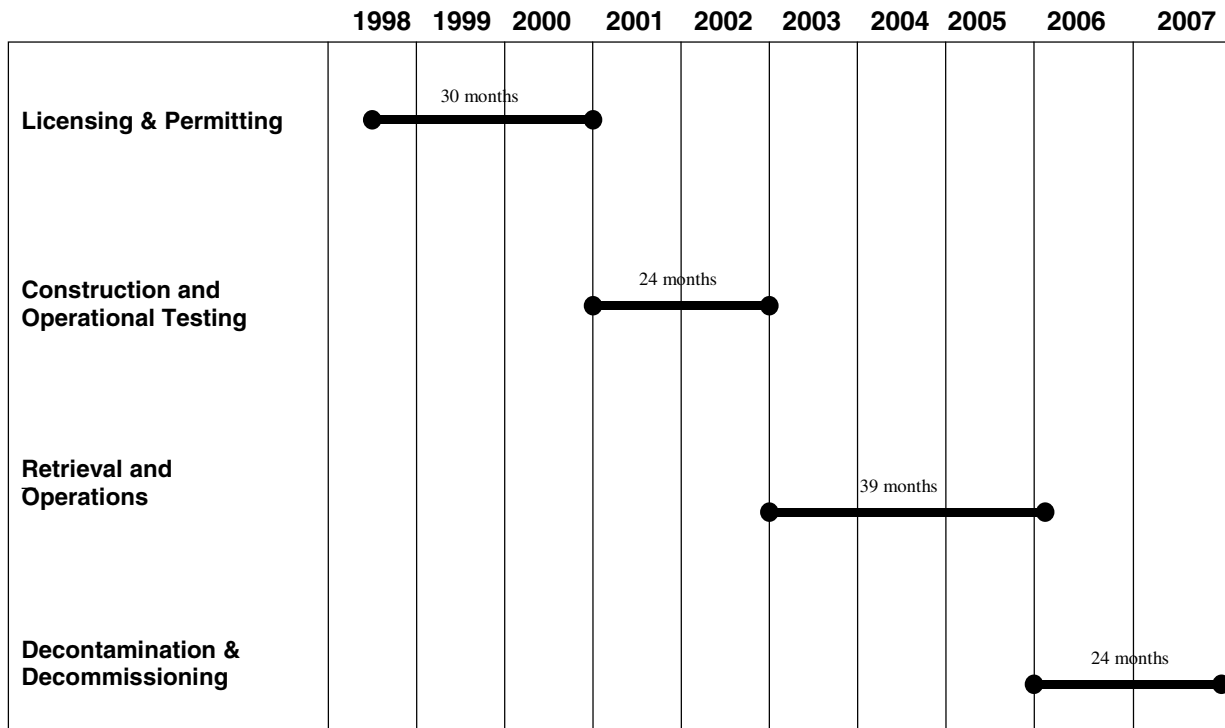


Figure 2-10. Vitrification Alternative project schedule.

Vitrification Alternative Waste Treatment Schedule

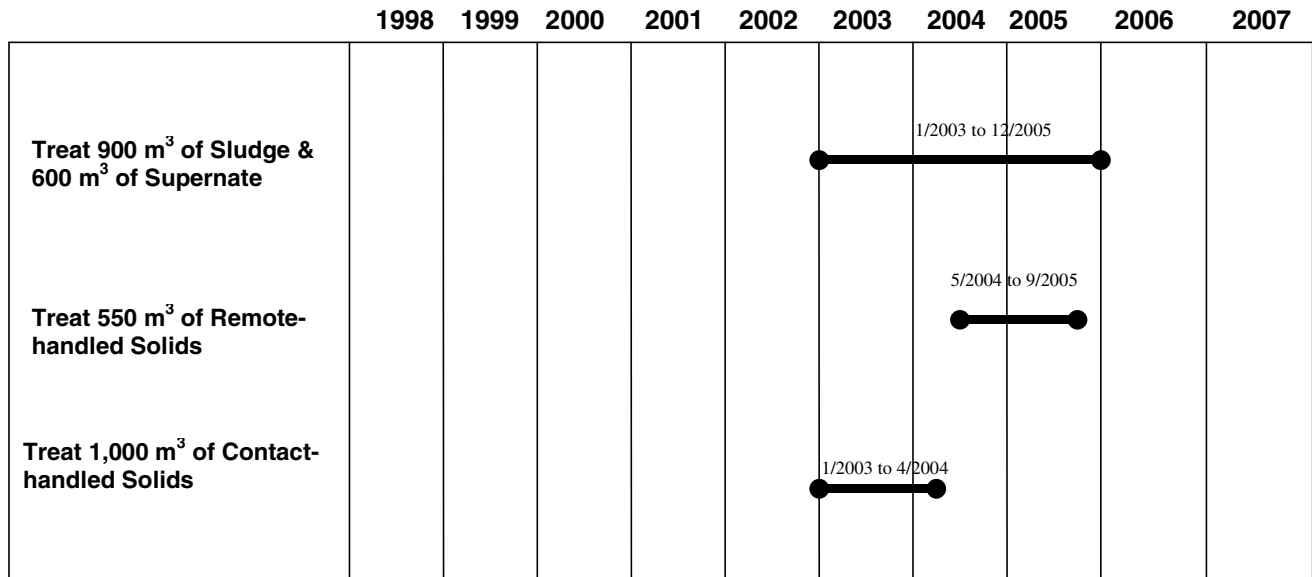


Figure 2-11. Vitrification Alternative waste treatment schedule.

2.6 CEMENTATION ALTERNATIVE

The Cementation Alternative consists of sludge and supernate separation by hydrocyclone/centrifuge pre-treatment and subsequent cementation for the tank wastes, and segregation and supercompaction for the contact-handled and remote-handled solid wastes.

2.6.1 Facility Description

The facility for the Cementation Alternative would be located within an approximate 2-ha (5-acre) plot of land located immediately west of the Melton Valley Storage Tanks. The process building would be a three-and-one-half-story structure. The facility would be a 37 m × 61 m × 14 m (120 ft × 200 ft × 45 ft) steel-framed structure with concrete and steel shielding. The total floor area of the cementation facility would be approximately 5,575 m² (60,000 ft²), with an estimated 1,860 m² (20,000 ft²) for the process area and 3,720 m³ (40,000 ft³) for the process support area. Doublewide trailers would be brought onto the site to provide approximately 560 m² (6,000 ft²) for the administration area that would be detached from the process building.

2.6.2 Waste Treatment Description

The cementation technology is based on operations conducted at DOE's Hanford facility near Richland, Washington, and information provided in a feasibility study (Parallax 1995). As pollution prevention measures, storm water would be diverted around the facility and gate valves would be installed in the diversion basins to retain spills. The off-gas system would minimize air emissions, and liquid used for the decontamination of the cementation treatment system would be transferred back into the cementation treatment system as waste minimization measures. A summary of volumes of primary, secondary, and decontamination and decommissioning waste is included in [Table 2-3](#).

2.6.2.1 Tank waste treatment (sludge and supernate)

Supernate and sludge would be transferred to the proposed facility through an above ground double-contained pipeline. Sludge would be removed from the tank by sluicing. The Cementation Alternative would use hydrocyclone and centrifuge waste pre-treatment to separate the supernate from the sludge. The majority of the liquids would be recycled through the Melton Valley Storage Tanks for sludge mobilization. After separation, the pretreated sludges and supernates would be treated by cementation ([Figure 2-12](#)). The facility would oscillate between treatment for supernate and treatment for sludge.

The initial step would be pretreatment to remove excess liquid from the sludge/supernate mixture following sludge retrieval. The pretreatment process would include storage tanks for the sludge/supernate, feed tanks for the cement mixer, metering equipment for pH adjustment additives, and associated pumps and instrumentation. A hydrocyclone in series with a centrifuge would separate the sludge from the supernate. The hydrocyclone is a centrifugal device with no moving parts. Solids from the hydrocyclone would gravity drain into the feed tank. The centrifuge would receive the effluent from the hydrocyclone and then provide a sufficiently high gravity force to effectively remove suspended solids ranging from 1 to 20% weight, with particle sizes ranging from 2 to 150 μm, at a flow rate up to 60 gal per minute (actual flow rate would be dependent on the rate of sludge and supernate retrieval from the Melton Valley Storage Tanks). A back-drive system would be included with the centrifuge design to maintain a desired slurry discharge of 25% weight total suspended solids. A supernate collection tank would temporarily hold the liquid streams from the hydrocyclone and centrifuge before the supernate is pumped back for sludge mobilization.

Table 2-3. Summary of projected waste volumes for the Cementation Alternative

Waste Stream	Category	Projected Volume Out ^a	Treatment Requirement
<i>Primary Waste Streams</i>			
Sludge	TRU	1,287 m ³	Cementation
Supernate	Remote-handled low-level waste	2,453 m ³	Cementation
Contact-handled solids	TRU	260 m ³	Various
Remote-handled solids	TRU	116 m ³	Various
Remote-handled solids	Remote-handled low-level waste	87 m ³	Various
<i>Secondary Waste Streams</i>			
Primary waste containers			
Remote-handled casks	Low-level waste	946 m ³	Volume reduction
Contact-handled drums and boxes	Low-level waste	36 m ³	Volume reduction
Construction debris	Sanitary	200 m ³	None
PPE (gloves, booties, etc.) ^b	Low-level waste	384 m ³	Volume reduction
HEPA filters ^b	Low-level waste	83 m ³	Volume reduction
Consumables (rags, towels, etc.) ^b	Low-level waste	257 m ³	Volume reduction
Mechanical/maintenance items	Low-level waste/TRU	130 m ³	Volume reduction
Laboratory solvents and residues	Low-level waste/mixed waste/TRU	2 m ³	Vitrification, stabilization
Sanitary solids	Sanitary	2,217 m ³	Capture
Sanitary wastewater	Sanitary	5,020 m ³	Capture
<i>Decontamination and Decommissioning Waste Streams</i>			
Concrete rubble	Construction debris	14,111 m ³	None
Free release metals	Recycle, reuse	77 m ³	None
Non-contaminated metals	Construction debris	32 m ³	None
Contaminated materials	Low-level waste	1,127 m ³	Volume reduction
Special materials	Low-level waste/ mixed waste	1 m ³	Stabilize, special treatment

^aVolumes are waste product volumes in the final disposal containers.

^bIf the waste is determined to be hazardous, the waste would also be macroencapsulated.

HEPA - High-Efficiency Particulate Air.

TRU - transuranic.

PPE - personal protective equipment.

The stainless steel feed tanks would be sized to allow continuous transfer of the sludge and supernate to the cementation facility. The feed tanks would be filled by the bottoms discharge of the hydrocyclone and centrifuge, and would contain approximately 25% weight total suspended solids. The feed tanks could also perform as settling tanks, if maintenance downtime is required for the centrifuge or hydrocyclone. Agitators would provide the required continuous mixing of the sludge, and a decant pump would remove any excess effluent. The feed tanks would be plumbed for metering the pH adjustment solution (e.g., HCl and NaOH). The metered waste slurry would be transferred from the feed tanks to the cementation batch process system using positive displacement pumps ([Figure 2-12](#)).

A dry blend storage tank assembly would store the premixed cementation/stabilization agents, and would consist of feed input, storage, and feed transfer systems. Premixed cementation/stabilization blends would be conveyed pneumatically to the storage bin. In-line sampling capability would be provided for the pneumatic feed conveyance system to verify the premix chemistry. Storage of the stabilization

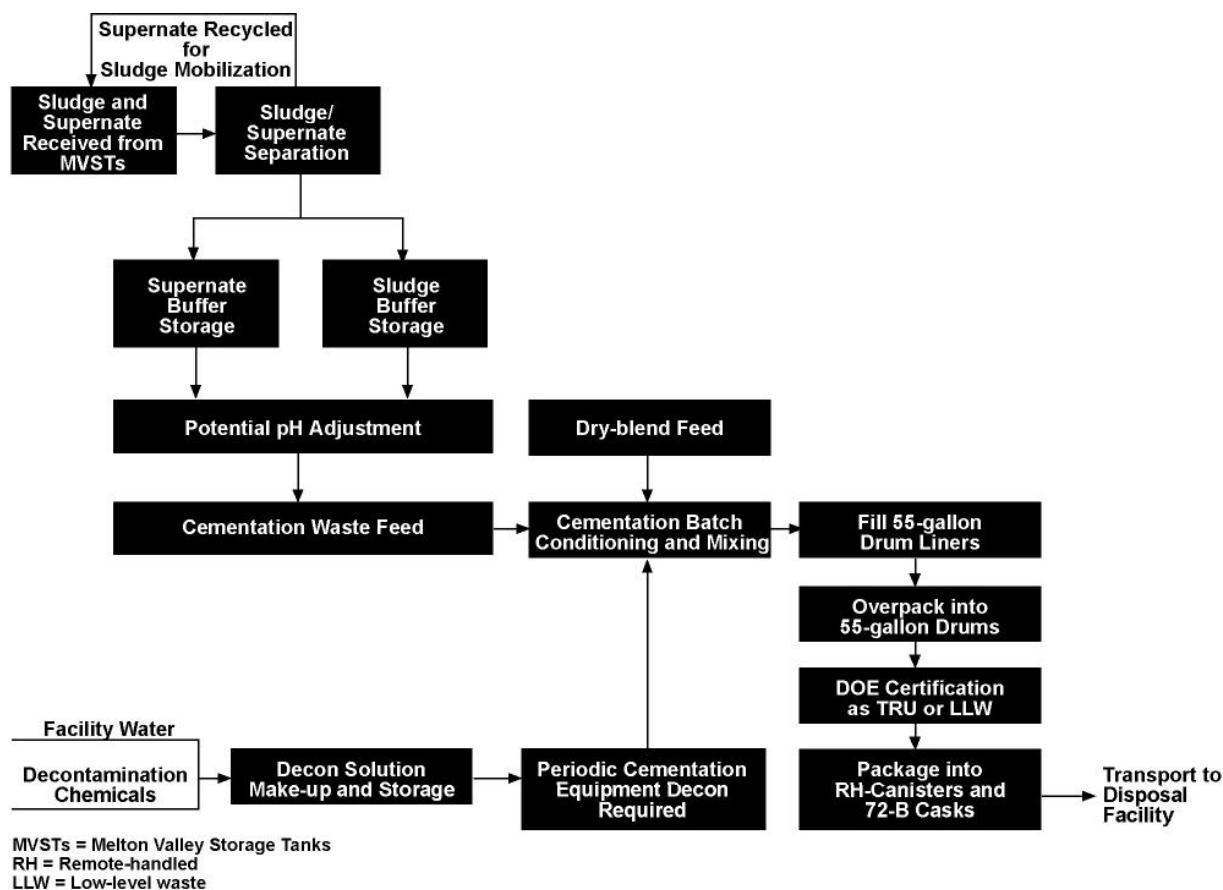


Figure 2-12. Flow diagram for tank waste treatment for the Cementation Alternative.

mixture would be provided by a vibrating bottom hopper fitted with mechanically activated level switches, and air pulse mixing that would be ducted to a baghouse and eventually to HEPA filters for air discharge. The feed transfer system would include a weigh belt feeder, transfer conveyor, transport blower, and tramp screen that feeds stabilization mixtures through a rotary valve. A truck would deliver the dry blend to the treatment facility, for deposit into the dry blend storage tank, which would contain enough premixed blend to process sludge for 5 to 7 days. Approximately 7 lbs of dry blend consisting of 33, 20, 19, 20, and 20% weight of slag, cement, fly ash, perlite, and Indian Red Pottery Clay, respectively, (Spence and Gilliam 1998) would be added per gallon of sludge to obtain a stable treated waste product. Approximately 11 lbs of dry blend would be added per gallon of supernate, and would consist of 40, 40, 16, and 4% weight of slag, cement, fly ash, and perlite, respectively.

The dry blend premix would be transferred through the vibrating bin bottom and injected with air for fluidization, then through a rotary airlock to a weigh belt feeder into the cementation mixer. The feed tank metering pump would transfer the waste slurry to the mixer. The cementation mixer is a high-energy, low-shear, twin-screw device that gravity discharges the cement blend into a conical surge tank. The surge tank includes an agitator, and an integral pump controls its level. A grout pump would discharge the waste slurry mixture into 50-gal drum liners. The drum liners would be filled by weighing and float control instrumentation. Approximately three 50-gal carbon steel liners could be filled on an hourly basis. The filled liners would remain on the conveyor system for a minimum of 4 hours to allow the cement to

harden, then the liners would be placed inside 55-gal carbon steel overpack drums. A remote manual manipulator would perform external surface contamination analysis of the overpack drums. After passing the analysis, the drums would be transferred to the interim storage area before placement into remote-handled canisters and, ultimately, 72-B casks. It is anticipated that operations would oscillate between cementation of sludge and cementation of supernate on a weekly basis. The treated supernate would be remote-handled low-level waste and would be disposed of at the Nevada Test Site. The treated TRU sludge would be disposed of at the Waste Isolation Pilot Plant.

In addition to the dust collection and filtration (i.e., a baghouse and HEPA filters) for the grout dry blending mixture, particulate emissions would be collected using HEPA filters. The cementation mixing process would contain several spray nozzles to clean the mixer, conveyors, surge tank, and the liquid collection tank. Decontamination chemicals would be used with a cementation pipeline-clearing pump to flush the lines each time the process is stopped, with discharge routed to a liquid collection tank. The contents of the liquid collection tank would be pumped to the pretreatment process for separation and transfer to the supernate collection tank for cementation treatment.

2.6.2.2 Solid waste treatment (remote-handled and contact-handled solids)

In general, treatment of the remote-handled and contact-handled solid waste would include waste receipt, assaying, opening, sorting, treatment, repacking, compaction, overpacking, grouting, DOE certification, packing in transport containers, and transport to the appropriate disposal facility. The solids treatment for the Cementation Alternative is identical to the Vitrification Alternative. Please refer to Section 2.4.2.2 for detailed information about this process.

2.6.3 Schedule of Activities

The total project duration of the Cementation Alternative is approximately 12.5 years, with 6 years involving waste treatment, during which offsite shipments of treated waste to the appropriate disposal facility would occur. The Cementation Alternative would require a longer waste treatment time, which would reduce the radiochemical and particulate emissions in a given year. The longer treatment time is due to the availability of shipments to the Waste Isolation Pilot Plant. The longer treatment time is a result of the shipment capacity allotment given by the Waste Isolation Pilot Plant to each approved shipper of certified TRU waste. (If the allocated shipment allotment from the Waste Isolation Pilot Plant were not a limiting factor, the sludge and supernate could be treated by this alternative treatment method in 1 or 2 years. The Cementation Alternative's treatment schedule for the waste streams was developed to keep the same number of operating shifts as required for sludge treatment to minimize operating the equipment. This approach would also allow for reduction in peak personnel loading and related personnel support facilities. The overall project schedule is depicted in [Figure 2-13](#). Further schedule detail for the tank and solid waste treatment is provided in [Figure 2-14](#).

Waste treatment would be conducted in the cementation facility for a period of 6 years with a designed treatment rate of 1.25 gal per minute of sludge/supernate. In order to process the sludge and supernate in 6 years, the cementation facility would need to be operational at least 70% of the year and would require one 8-hour shift per day for 5 days a week. Contact-handled solids would be treated first and would normally proceed at a rate of approximately 6.5 drum equivalents per day on a 1-shift, 5-day basis. Contact-handled solid waste treatment would require approximately 2.5 years of operations. The remote-handled solid wastes would be treated after the contact-handled solids and would proceed at a rate of approximately 0.7 casks per shift on an 8-hour shift per day, 5-day basis. Remote-handled solid waste treatment would require 3 years, based on the facility being operational 80% of the year.

Cementation Alternative Schedule

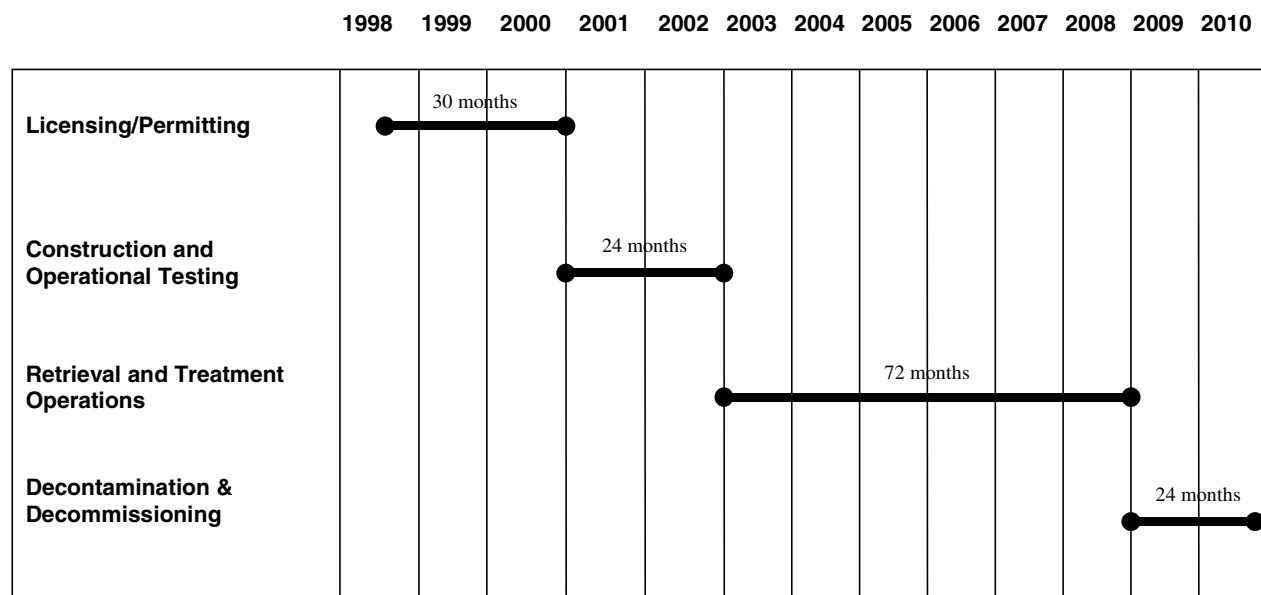


Figure 2-13. The Cementation Alternative Schedule shows the project would take approximately 12.5 years to complete.

Cementation Alternative Waste Treatment Schedule

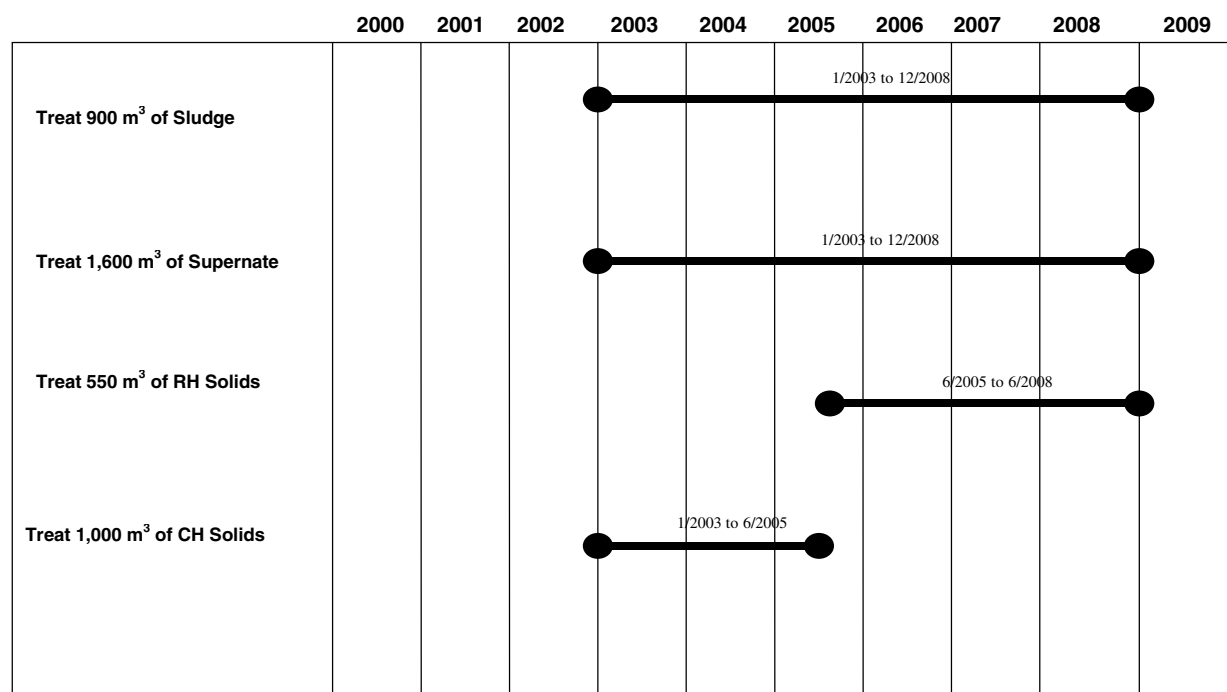


Figure 2-14. The Cementation Alternative waste treatment schedule would take approximately 6 years.

2.7 TREATMENT AND WASTE STORAGE AT ORNL ALTERNATIVE

DOE intends to ship treated waste offsite for disposal as soon as the waste is treated. However, in the event that disposal capacity is unavailable immediately upon completion of waste treatment, DOE has included the Treatment and Waste Storage at ORNL Alternative to provide safe, interim, on-site storage capacity until off-site disposal capacity is available.

This alternative would entail waste treatment by any of the three previous treatment alternatives (low-temperature drying, vitrification, or cementation) and interim waste storage at ORNL rather than immediate shipment to an off-site disposal facility (i.e., the Waste Isolation Pilot Plant for TRU waste, and the Nevada Test Site for low-level waste). Treated remote-handled wastes would require remote handling during on-site storage at ORNL because of the associated doses. Implementation of this alternative would result in noncompliance with the milestone established in the TDEC Commissioner's Order requiring the submittal of a Project Management Plan (which includes schedules for treatment and shipment) by September 30, 2001. In addition, this alternative would jeopardize the existing "target date" established in the TDEC Commissioner's Order for initiation of shipment of the stabilized remote-handled TRU sludges to the Waste Isolation Pilot Plant by January 2003. For purposes of analysis, DOE has evaluated a 100-year institutional control period, after which there would be a loss of institutional control.

2.7.1 Facility Description

2.7.1.1 Waste treatment facility

Because this alternative would include waste treatment by any of the three treatment alternatives previously described, please refer to these previous sections for a description of the waste treatment facilities for low-temperature drying, vitrification, and cementation.

Waste Treatment Facility Description	Section
Low-Temperature Drying	Section 2.4.1
Vitrification	Section 2.5.1
Cementation	Section 2.6.1

2.7.1.2 Waste storage facilities

On-site waste treatment would result in primary, secondary, and D&D waste streams that would consist of remote-handled TRU waste; contact-handled TRU wastes; low-level waste; remote-handled low-level waste; and mixed waste, which would require on-site storage at ORNL. This alternative would require the construction of new waste storage facilities. Several assumptions were made to determine the storage space required for the waste streams resulting from waste treatment.

1. It was assumed that a required engineering analysis would indicate that the existing storage bunkers for remote-handled and mixed waste (Buildings 7855 and 7883) could be used to store treated TRU and remote-handled low-level wastes. These bunkers would provide 320 m³ of storage capacity.
2. It was assumed that the existing metal buildings that store contact-handled TRU waste (Buildings 7572, 7574, 7842, 7878, and 7879) would be used for treated low-level waste storage. These buildings would provide 1,631 m³ (57,632 ft³) of storage capacity for low-level waste.
3. It was assumed that the new storage facilities would have similar waste storage capacities [approximately 150 m³ for each remote-handled waste bunker, and approximately 300 m³ (10,600 ft³) for each metal building].

4. It was assumed that the building footprints (area) for the new storage facilities, and for their construction, would be similar to the existing storage facilities (234 m² remote-handled waste storage bunkers and 375 m² metal storage buildings for low-level waste).
5. It was assumed that the new waste storage facilities would be located in the Melton Valley area of ORNL, preferably near the waste treatment facility or the existing TRU waste storage facilities.

Tables 2-4a, -b, and -c provide a summary of the resulting waste volumes of the three waste treatment alternatives and the new storage space required for the resulting waste streams. The construction of new waste storage facilities would need to coincide with the construction of the selected waste treatment facility in order to be ready for the receipt of the treated waste streams. The number of new storage facilities needed for the treated wastes would be dependent on the treatment method chosen. DOE considered the need for additional shielding when the space requirements for additional storage capacity were calculated.

2.7.2 Waste Treatment Description

This alternative would include waste treatment by any of the three treatment approaches previously described (low-temperature drying, vitrification, or cementation), and then interim storage onsite at ORNL. Please refer to these previous sections for the descriptions of the waste treatments that would be implemented if this alternative were selected.

Waste Treatment Description	Section
Low-Temperature Drying	Section 2.4.2
Vitrification	Section 2.5.2
Cementation	Section 2.6.2

2.7.3 Schedule of Activities

This alternative would include interim storage of the waste at ORNL following waste treatment. For purposes of analyses, institutional control is assumed for a period of 100 years, followed by a loss of institutional control. The schedules for waste treatment were discussed in previous sections, as noted below. Construction of additional waste storage facilities would need to coincide with the construction of the waste treatment facility in order to have facilities available to store the treated wastes following waste treatment and repackaging. It is assumed that the schedules would be similar to the facility construction schedule, which would allow for about 2 years for construction.

Waste Treatment and D&D Schedule	Section
Low-Temperature Drying Alternative	Section 2.4.3
Vitrification Alternative	Section 2.5.3
Cementation Alternative	Section 2.6.3

Table 2-4. Summary of the TRU, mixed low-level, remote-handled low-level, and low-level waste volumes (includes D&D waste), the resulting new storage space required for each treatment alternative, and the land area required for additional storage facilities

	Low-Temperature Drying	Vitrification	Cementation
Table 2-4a. Summary of the TRU, mixed low-level, and remote-handled low-level waste volumes and new storage space required			
Treated TRU waste volume (m ³) ^a	607	1,060	1,793
Mixed low-level waste volume (m ³)	23	4	3
Treated remote-handled low-level waste volume (m ³)	—	—	2,540 ^b
Total TRU, mixed, and remote-handled low-level waste requiring on-site storage (m³)	630	1,064	4,336
Existing waste bunkers storage capacity (m ³)	320	320	320
New storage capacity needed (m³)^c	310	744	4,016
Assumed capacity of single new waste bunker (m ³)	150	150	150
Number of new waste bunkers needed	3	5	27
Assumed area of new waste bunker (m ²)	234	234	234
Total Storage Facility Area required for TRU, mixed, and remote-handled low-level wastes (m²)	702	1,161	6,265
Table 2-4b. Summary of low-level waste volumes and new storage space required			
Total low-level waste requiring on-site storage (m³)	2,778^a	4,983^a	2,833^a
Existing storage capacity (metal building)	1,631	1,631	1,631
New storage capacity needed (m³)^c	1,147	3,352	1,202
Assumed capacity of single new metal building (m ³)	300	300	300
Number of new metal buildings needed	4	11	4
Area of new metal buildings (m ²)	375	375	375
Total area required for low-level wastes (m²)	1,434	4,190	1,503
Table 2-4c. Total area required for all waste types and the associated land requirements for the new storage facilities			
TOTAL FACILITY SPACE REQUIRED FOR ALL WASTE TYPES (m²)	2,136	5,351	7,768
TOTAL HECTARES REQUIRED FOR NEW WASTE STORAGE FACILITIES^d	0.3	0.6	0.8

^aTRU waste volumes include both remote-handled and contact-handled waste.

^bTotal waste volumes include alpha-low-level waste.

^cDetermined by subtracting available capacity from resulting waste volume and dividing by assumed storage capacity of new facility (150 m³ for TRU, mixed, and remote-handle low-level wastes, and 300 m³ for low-level wastes).

^dDetermined by summing storage space required for all waste types, for each treatment method, and converting to hectares.

2.8 ALTERNATIVES CONSIDERED BUT NOT EVALUATED IN DETAIL

2.8.1 Off-site Waste Treatment

Currently there is no facility available or planned at any other DOE site that could treat remote-handled TRU mixed waste sludge and associated low-level waste supernate stored at ORNL. The Idaho National Engineering and Environmental Laboratory (INEEL) is planning to process its contact-handled TRU waste on-site at the planned Advanced Mixed Waste Treatment Project facility. DOE is not currently legally prohibited from shipping waste to the INEEL to be treated so long as the waste is treated and leaves INEEL within a specified time period. However, using the planned INEEL facility to treat ORNL TRU waste would be difficult for the following reasons:

- Because the planned INEEL facility is being constructed to process the contact-handled TRU waste at INEEL, the ORNL remote-handled TRU waste is not likely meet the planned facility's waste acceptance criteria.
- Most of the ORNL remote-handled and contact-handled TRU/alpha low-level solid waste containers do not meet DOT standards (49 *CFR* 173). These containers would require repackaging prior to transport offsite; therefore, it would be safer and more economical for the treatment of solid waste to be conducted at ORNL, and for the treated TRU waste to be shipped directly to the Waste Isolation Pilot Plant, and the treated low-level waste to be shipped directly to the Nevada Test Site.
- After treatment at INEEL, the ORNL treated waste would require a second redundant step of repackaging and DOE certification before the waste could be transported to the Waste Isolation Pilot Plant or the Nevada Test Site, resulting in additional worker exposures and cost.

Treatment of the ORNL TRU wastes at INEEL is unreasonable because of the increased costs and risks associated with preparing the tank waste for shipment, repackaging and certifying the waste twice, transporting the waste to INEEL for treatment, and then transporting the treated waste to the Waste Isolation Pilot Plant or the Nevada Test Site as appropriate.

2.8.2 Alternate On-site Treatment Facility Locations

Several factors were considered in selecting the site of the proposed on-site treatment facility. These factors are discussed in Section 2.1 and include minimizing the length of any sludge/supernate waste transfer line from the Melton Valley Storage Tanks to the proposed treatment facility, using the terrain to provide natural shielding for the proposed facility, and considering recommendations made in a Feasibility Study that focused on dealing with the tank wastes (Parallax 1995).

The proposed site is directly west of the Melton Valley Storage Tanks, which is the current storage area for the TRU mixed waste sludge and associated low-level supernate. This location reduces the potential risks associated with transporting the liquid and sludge tank wastes from the Melton Valley Storage Tanks to the proposed treatment facility over public or laboratory roads. Since the solid waste storage facilities are also located in Melton Valley, the transportation of the solid wastes would only occur on laboratory roads, also reducing the risk to the public. Melton Valley, while considered part of ORNL, is separated from the ORNL main plant area by the Haw Ridge ([Figure 2-1](#)), thus reducing potential risks to the main body of workers at ORNL from accidental releases. Alternative site locations were not evaluated in detail because other on-site locations did not meet the siting factors.

2.8.3 Alternative Disposal Locations

TRU waste will be disposed of at the Waste Isolation Pilot Plant in accordance with the WIPP SEIS-II Record of Decision (DOE 1998) for TRU waste. All low-level waste resulting from the ORNL TRU Waste Treatment Facility will be disposed of at the Nevada Test Site selected in the *Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-level and Mixed Low-level Waste; Amendment of the Record of Decision for the Nevada Test Site* (DOE 2000).

2.8.4 Alternative Treatment Technologies

Sixteen stabilization and solidification technologies were identified and evaluated as candidates for processing TRU waste sludge in the *Feasibility Study for Processing ORNL Transuranic Waste at Existing and Modified Facilities* (Parallax 1995), but were not analyzed further because they were not considered reasonable (Table 2-5). One of the technologies, plasma arc vitrification, was also identified as potentially useful for solid remote-handled and contact-handled TRU/alpha low-level waste. However, it would not be feasible to use a technology for the solid wastes unless it was also used for the sludge and supernate. Because of cost, scaling, and permitting issues, this technology was eliminated from further consideration.

Table 2-5. Summary of alternatives considered but not evaluated for sludge and supernate waste treatment

Treatment name	Summary description	Rationale for not evaluating
Aquaset II-H®	A non-thermal process that utilizes a powdered solidification agent developed for the immobilization of sludge through the action of complex bonding mechanisms and ion exchange reactions.	Not a proven technology, inability to treat multiple waste streams, its lack of ease with retreatment capabilities, and the excess amount of water used during the process.
Catalytic extraction	A thermal process that introduces sludge into a molten metal bath that acts as a catalyst to break down the waste into its elemental constituents.	Extensive chemical formulation is required for each changing waste stream.
Glass-ceramic vitrification	A thermal process that combines sludge with a ceramic feed material, then calcines in a spray calciner.	Not a proven technology for this type of waste and has a low tolerance to feed variations.
Bitumen solidification	A non-thermal process that uses either bitumen or asphalt as a high molecular weight hydrocarbon to encapsulate the sludge.	Gas generation from the degradation of the hydrocarbon material by alpha-emitting radionuclides.
Ceramic vitrification	A thermal process that combines sludge with ceramic powder and glass frits and then forms and heats into bricks in a brick former.	Not a proven technology for this type of waste and has a lower flexibility with treatment various wastes.
Microwave vitrification	A thermal process that combines glass frits and sludge, places the mixture into a microwave cavity, and melts.	Not proven at large scale; lower flexibility with treatment various waste.
In-can glass melting	A thermal process that first dries the sludge to a fine powder in a spray calciner, then combines the fine powder with glass frits and feeds it into a drum for heating.	Lacks multiple waste stream capabilities, lacks retreatment capabilities, and is not a proven technology for ORNL's waste stream.
Titanate	A thermal process that involves mixing supercalcine (a silicate-based material) with sludge and then calcining.	Increased waste loading, sensitivity to sodium waste streams, lack of multiple waste stream capabilities, lack of retreatment capabilities, and not being a proven technology for ORNL's waste stream.
Synroc hot-isostatic pressing	A thermal process that involves calcination of the sludge and then mixing it with synroc additives. Synroc is an acronym for a synthetic, igneous rock system that consists of thermodynamic-compatible minerals having the ability to capture radioactive waste elements in their crystal lattices.	Similar to the Titanate process.
Supercalcine hot-isostatic pressing	A thermal process that involves mixing supercalcine (a silicate-based material) with sludge and then calcining.	Similar to the Titanate process.
Cermet	A thermal process that involves dissolving and mixing sludge and cermet-forming additives in molten urea.	Similar to the Titanate process.
Fluetap concrete	This process combines the sludge with water, cement, fly ash, and clay in a mixer, then transfers the mix into a drum, and places it into an autoclave for 64 hours to accelerate hardening. The drum is then placed in an air-storage for several years to remove the free water from the concrete.	Failed to meet the schedule constraints.
Molten salts	A thermal process that introduces air to the sludge under a surface of a sodium carbonate-containing melt.	Failed to meet Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions (LDR) standards.
Supercalcine pellets-in-metal	A thermal process that combines supercalcine with sludge. Binders are added and the material is pelletized. The pellets are sintered to form the desired mineral phase, placed in drums, and encapsulated in lead.	Failed to meet RCRA LDR standards.
Marbles-in-lead matrix	A thermal process that creates marbles from a joule-heated molten glass/sludge mixture and then casts the marbles in lead.	Failed to meet RCRA LDR standards.
Polymer encapsulation	A non-thermal process that involves mixing vinyl ester styrene with sludge and then allows to cure in an in-drum mixer.	Failed to meet the Waste Isolation Pilot Plant waste acceptance criteria.

2.9 SUMMARY OF ENVIRONMENTAL IMPACTS

Table 2-6 is a summary of the potential environmental impacts associated with implementing the various alternatives considered in the EIS. These impacts are discussed in detail in Chapter 4, but are summarized here to allow comparison of the alternatives.

Table 2-6. Comparison of impacts among alternatives

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Land use (Chapter 4, Section 4.1)	<ul style="list-style-type: none"> No change in land use, land use classifications, or impacts to visual resources during 100-year institutional control period Assuming loss of institutional control, the land would be permanently committed to waste storage 	<ul style="list-style-type: none"> No change in land use classification 2 hectares (ha) (5 acres) would change from underdeveloped to industrial use Buildings and other structures would be visible to workers but not the public 	<ul style="list-style-type: none"> No change in land use classification 2 to 2.8 ha (5 to 7 acres) would change from underdeveloped to industrial use Buildings and other structures would be visible to workers but not the public 	<ul style="list-style-type: none"> No change in land use classification 2 ha (5 acres) would change from underdeveloped to industrial use Buildings and other structures would be visible to workers but not the public 	<ul style="list-style-type: none"> No change in land use classification 2 to 2.8 ha (5 to 7 acres) would change from underdeveloped to industrial use For waste storage after treatment, an additional 0.3 ha (0.75 acre) of land would be required if treatment was by low-temperature drying, 0.6 ha (1.5 acres) of land if by vitrification, or 0.8 ha (2.0 acres) of land if by cementation Buildings and other structures would be visible to workers but not the public Assuming loss of institutional control, the land would be permanently committed to waste storage
Cultural and historic resources (Chapter 4, Section 4.2)	<ul style="list-style-type: none"> No cultural, archeological, or historic resources in project area 	<ul style="list-style-type: none"> Same as No Action Alternative 	<ul style="list-style-type: none"> Same as No Action Alternative 	<ul style="list-style-type: none"> Same as No Action Alternative 	<ul style="list-style-type: none"> Same as No Action Alternative

ha
ORNL

= hectare.
= Oak Ridge National Laboratory.

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Ecological resources (Chapter 4, Section 4.3)	<ul style="list-style-type: none"> Continued release of waste constituents from SWSA 5 North trenches to soils and groundwater affecting biota No habitat destruction under continued storage Minimal impact (HQ for aquatic biota at steady-state would be 7×10^{-7}) from slow release of MVSTs wastes after loss of institutional control Assuming loss of institutional control, wastes from SWSA 5 North trenches, bunkers, and buildings would serve as long-term contaminant sources 	<ul style="list-style-type: none"> 2 ha (5 acres) of forested habitat lost and converted to industrial use (revegetated after facility D&D) Reduction of soil and water contamination because treatment would be available for waste to be removed from SWSA 5 North trenches under CERCLA 	<ul style="list-style-type: none"> 2 to 2.8 ha (5 to 7 acres) of forested habitat lost and converted to industrial use (revegetated after facility D&D) Reduction of soil and water contamination because treatment would be available for waste to be removed from trenches under SWSA 5 North CERCLA 	<ul style="list-style-type: none"> 2 ha (5 acres) of forested habitat lost and converted to industrial use (revegetated after facility D&D) Reduction of soil and water contamination because treatment would be available for waste to be removed from SWSA 5 North trenches under CERCLA 	<ul style="list-style-type: none"> 2 to 2.8 ha (5 to 7 acres) of forested habitat lost and converted to industrial use Low-quality habitat indefinitely lost for on-site waste storage facility construction; 0.3 ha (0.75 acre) of land required if treatment by low-temperature drying, 0.6 ha (1.5 acres) of land if by vitrification, and 0.8 ha (2.0 acres) of land if by cementation Reduction of soil and water contamination because treatment would be available for waste to be removed from SWSA 5 North trenches under CERCLA Assuming loss of institutional control, waste constituents would eventually be released but impacts would be less than No Action because the wastes would be treated and better contained

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act (see Table 5-1).
 D&D = decontamination and decommissioning.
 ha = hectare.
 HQ = hazard quotients.
 MVSTs = Melton Valley Storage Tanks.
 ORNL = Oak Ridge National Laboratory.
 SWSA 5 North = Solid Waste Storage Area 5 North.

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Geology and seismicity (Chapter 4, Section 4.4)	<ul style="list-style-type: none"> • No impact to geology or regional seismicity • No construction-related impacts to soils or geology • Continued release of waste constituents from the SWSA 5 North trenches to soils during and after loss of institutional control • Eventual release of wastes from MVSTs and SWSA 5 North bunkers and buildings into soils after loss of institutional control 	<ul style="list-style-type: none"> • No impact to geology or regional seismicity • 2 ha of soil disturbed • Reduction of soil and water contamination because treatment would be available for waste to be removed from SWSA 5 North trenches under CERCLA 	<ul style="list-style-type: none"> • No impact to geology or regional seismicity • 2.8 ha of soil disturbed • Reduction of soil and water contamination because treatment would be available for waste to be removed from SWSA 5 North trenches under CERCLA 	<ul style="list-style-type: none"> • No impact to geology or regional seismicity • 2 ha of soil disturbed • Reduction of soil and water contamination because treatment would be available for waste to be removed from SWSA 5 North trenches under CERCLA 	<ul style="list-style-type: none"> • No impact to geology or regional seismicity • 2 to 2.8 ha of soil disturbed • Reduction of soil and water contamination because treatment would be available for waste to be removed from SWSA 5 North trenches under CERCLA • Eventual release of constituents of treated waste after loss of institutional control

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act (see Table 5-1).
 ha = hectare.
 MVSTs = Melton Valley Storage Tanks.
 ORNL = Oak Ridge National Laboratory.
 SWSA 5 North = Solid Waste Storage Area 5 North.

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Surface water (Chapter 4, Section 4.5.1)	<ul style="list-style-type: none"> Continued release of waste constituents from the SWSA 5 North trenches to surface water during and after loss of institutional control Eventual release of long-lived radionuclides from MVSTs and SWSA 5 North bunkers and buildings into surface water 	<ul style="list-style-type: none"> Potential for increased siltation in White Oak Creek, Melton Branch, and an unnamed tributary Reduction of soil and water contamination because treatment would be available for waste to be removed from SWSA 5 North trenches under CERCLA 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative during institutional control After loss of institutional control, waste constituents would eventually be released but impacts would be less than No Action because wastes are treated and better contained
Groundwater (Chapter 4, Section 4.5.2)	<ul style="list-style-type: none"> No groundwater use Continued release of waste constituents from SWSA 5 North trenches during and after loss of institutional control Eventual release of wastes from MVSTs and SWSA 5 North bunkers and building into groundwater after loss of institutional control 	<ul style="list-style-type: none"> No groundwater use Positively impacts groundwater due to waste removal and treatment of waste from SWSA 5 North trenches 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative during institutional control Eventual release of constituents of treated waste after loss of institutional control, but impacts would be less than No Action because wastes are treated and better contained

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act (see Table 5-1).
 MVSTs = Melton Valley Storage Tanks.
 ORNL = Oak Ridge National Laboratory.
 SWSA 5 North = Solid Waste Storage Area 5 North.

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Wetlands & Floodplains (Chapter 4, Section 4.5.3)	<ul style="list-style-type: none"> Continued impacts to White Oak Creek floodplain due to SWSA 5 North contamination No impact to wetlands during institutional control After institutional control period, wastes would eventually contaminate wetlands After loss of institutional control, continue to impact floodplain 	<ul style="list-style-type: none"> Small impact from sedimentation to the 100-year or 500-year floodplains during construction phase Wetland B (0.012 ha or 0.03 acres) would be eliminated by construction, but would be mitigated 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative during institutional control Eventual release of constituents of treated waste after loss of institutional control

ha = hectare.
ORNL = Oak Ridge National Laboratory
SWSA 5 North = Solid Waste Storage Area 5 North.

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Waste Management (Chapter 4, Section 4.6)	<ul style="list-style-type: none"> • TRU sludge wastes and associated low-level supernate in the MVSTs solid wastes in SWSA 5 North trenches, and solid waste in storage facilities would remain untreated • Would require continued surveillance and maintenance of untreated legacy waste inventory and associated on-site facilities indefinitely at ORNL • Would result in violation of legal mandate due to continued waste storage, potentially resulting in fines 	<ul style="list-style-type: none"> • All legacy wastes in proposed action would be treated • Approximately 10,833 m³ of total generated waste, including: <ul style="list-style-type: none"> - 607 m³ CH and RH TRU waste; - 2,778 m³ low-level waste; - 23 m³ of low-level mixed waste; - 1,560 m³ of sanitary wastewater; and - 5,550 m³ debris from D&D activities 	<ul style="list-style-type: none"> • Same as Low-Temperature Drying Alternative • Approximately 34,128 m³ of total waste generated, including: <ul style="list-style-type: none"> - 1,060 m³ CH and RH TRU waste; - 4,980 m³ low-level waste; - 4 m³ of low-level mixed waste; - 7,201 m³ of sanitary wastewater; and - 20,760 m³ debris from D&D activities 	<ul style="list-style-type: none"> • Same as Low-Temperature Drying Alternative - Approximately 28,826 m³ of total waste generated, including: <ul style="list-style-type: none"> - 1,793 m³ CH and RH TRU waste; - 2,833 m³ low-level waste; - 2,540 m³ of remote-handled low-level waste; - 3 m³ of low-level mixed waste; - 7,437 m³ of sanitary wastewater; and - 14,143 m³ debris from D&D activities 	<ul style="list-style-type: none"> • Same as Low-Temperature Drying Alternative • 10,833 to 34,128 m³ of waste generated, depending on the treatment selected, and stored on-site • Would require continued surveillance and maintenance of waste inventory for interim onsite storage at ORNL • Would require construction of additional waste storage facilities—using 0.3 to 0.8 ha of land depending upon treatment process selected

CH = contact-handled.
D&D = decontamination and decommissioning.
m³ = cubic meters.
MVSTs = Melton Valley Storage Tanks.
ORNL = Oak Ridge National Laboratory.
RH = remote-handled.
SWSA 5 North = Solid Waste Storage Area 5 North.

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Climate and Air Quality (Chapter 4, Section 4.7)	<ul style="list-style-type: none"> No impact to air quality 	<ul style="list-style-type: none"> Minor emissions during normal operations; slightly higher volatile organic emissions 	<ul style="list-style-type: none"> Minor emissions during normal operations; slightly higher nitrogen dioxide emissions 	<ul style="list-style-type: none"> Minor emissions during normal operations; slightly higher particulate emissions. 	<ul style="list-style-type: none"> Minor emissions during normal operations
Transportation (Chapter 4, Section 4.8)	<u>On-site Retrieval and Transport</u> <ul style="list-style-type: none"> No on-site waste shipments 	<u>On-site Retrieval and Transport</u> <ul style="list-style-type: none"> 300 shipments of RH waste from trenches and bunkers, and 245 shipments of CH waste to treatment facility Retrieval accidents could result in 6.3E-05 LCFs (public) and 7.5E-04 industrial fatalities to involved workers Transportation accidents could result in 2.9E-05 LCF (public) and 3.3E-05 non-radiological fatalities Total risks to non-involved workers and public MEI are 5.3E-07 and 6.2E-09 probability of cancer fatality, respectively 8.0E-03 LCF (involved worker (based on 1 rem/year assumed dose limit) 	<u>On-site Retrieval and Transport</u> <ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative 	<u>On-site Retrieval and Transport</u> <ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative 	<u>On-site Retrieval and Transport</u> <ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative for retrieval accidents and radiological transportation accidents 3,339 shipments of treated waste to storage facility using cementation as a bounding case 2.3E-04 transportation related fatalities 3.4E-04 construction fatalities (involved workers) 2.5E-03 loading and unloading accident fatalities (involved workers)

CH = contact-handled.
LCF = latent cancer fatalities.
ORNL = Oak Ridge National Laboratory.
MEI = maximally exposed individual.
RH = remote-handled.

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Transportation (continued) (Chapter 4, Section 4.8)	<u>Off-site Transport</u> <ul style="list-style-type: none"> No off-site shipments 	<u>Off-site Transport</u> <ul style="list-style-type: none"> 397 shipments of TRU waste with 3.2E-01 accidents and 4.4E-02 fatalities predicted Non-accident LCFs of 8.7E-03 for CH TRU and 3.1E-02 for RH TRU waste 277 low-level waste shipments with 2.6E-01 accidents and 3.6E-02 accident fatalities predicted 2.1E-09 non-accident LCFs predicted 	<u>Off-site Transport</u> <ul style="list-style-type: none"> 989 shipments of TRU waste with 8.0E-01 accidents and 1.1E-01 fatalities predicted Non-accident LCFs of 5.3E-03 for CH TRU and 9.3E-02 for RH TRU waste 281 low-level waste shipments with 2.6E-01 accidents and 3.6E-02 accident fatalities 2.1E-09 non-accident LCFs predicted 	<u>Off-site Transport</u> <ul style="list-style-type: none"> 2,425 shipments of TRU waste with 2.2 accidents and 3.0E-01 fatalities predicted Non-accident LCFs of 5.3E-03 for CH TRU and 2.7E-01 for RH TRU waste 914 low-level waste shipments with 8.8E-01 accidents and 1.2E-01 accident fatalities predicted 7.5E-09 non-accident LCFs predicted 	<u>Off-site Transport</u> <ul style="list-style-type: none"> No off-site shipment of TRU waste or low-level waste

CH = contact-handled.
 LCFs = latent cancer fatalities.
 ORNL = Oak Ridge National Laboratory.
 RH = remote-handled.
 TRU = transuranic.

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Utility Requirements (Chapter 4, Section 4.9)	<ul style="list-style-type: none"> Total estimated power usage 2,200 MW 5 million gal of water use projected over 100-year institutional control period 	<ul style="list-style-type: none"> About 15,000 MW of total electricity usage 5 million gal of water use during project life 	<ul style="list-style-type: none"> About 45,000 MW of total electricity usage 7 million gal of water use during project life 	<ul style="list-style-type: none"> About 11,250 MW of total electricity usage 15 million gal of water use during project life 	<ul style="list-style-type: none"> Electricity use varies by alternative from 13,450 MW to 47,200 MW total, which includes electricity use for interim storage Water use varies by alternative (10 million to 20 million gal), which includes water use for interim storage
Human Health (Chapter 4, Section 4.10)	<ul style="list-style-type: none"> LCFs for involved worker population estimated to be 2E-02 Risk to public and non-involved worker would be negligible during institutional control period After loss of institutional control, higher risks to public from contaminated surface water, groundwater, and food supplies 	<ul style="list-style-type: none"> PCF from radiological releases to involved worker estimated to be 3.0E-08; non-involved worker estimated to be 2.0E-08; and off-site MEI estimated to be 1.0E-08 Collective dose to the affected off-site public population would be 1.2E-01 person-rem, resulting in 6.0E-05 LCFs 	<ul style="list-style-type: none"> PCF from radiological releases to involved worker estimated to be 9.0E-08; non-involved workers estimated to be 7.0E-08; off-site MEI estimated to be 5.0E-08 Collective dose to the affected off-site public population would be 6.8E-01 person-rem, resulting in 3.0E-04 LCFs 	<ul style="list-style-type: none"> PCF from radiological releases to involved worker estimated to be 6.0E-09; non-involved workers estimated to be 5.0E-09; and off-site MEI estimated at 3.0E-09 Collective dose to the affected off-site public population would be 2.8E-02 person-rem, resulting in 1.0E-05 LCFs 	<ul style="list-style-type: none"> LCF for involved worker population estimated to be 2E-02 PCF for the non-involved worker and off-site MEI would be equal to that estimated for the treatment technology selected Collective dose and number of fatalities for the affected off-site population would be equal to that for the treatment technology selected After loss of institutional control, higher risks to public from contaminated surface water, groundwater, and food supplies, but less risk than No Action Alternative since wastes are treated and better contained

LCFs = latent cancer fatalities.
 MEI = maximally exposed individual.
 MW = megawatt(s).
 ORNL = Oak Ridge National Laboratory.
 PCF = probability of cancer fatality.

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Noise (Chapter 4, Section 4.12)	<ul style="list-style-type: none"> Noise levels at 50 to 60 dBA 	<ul style="list-style-type: none"> Site construction and D&D noise up to 70 dBA Noise levels during operations at 50 to 60 dBA Noise increases are temporary and minor 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative 	<ul style="list-style-type: none"> Same as Low-Temperature Drying Alternative during treatment and would decrease, similar to the levels of No Action, during interim storage

dBA = decibels as recorded on the A-weighted scale of a standard sound level meter.
 D&D = decontamination and decommissioning.
 ORNL = Oak Ridge National Laboratory.

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Accidents (Chapter 4, Section 4.11)	<ul style="list-style-type: none"> • MVSTs Breach¹ <ul style="list-style-type: none"> - MEI – 1.1E-05 PCF - Population – 1.1 LCF during institutional control and 11 LCF after loss of institutional control - Non-involved workers – 9.2E-04 PCF • Vehicle impact (CH TRU and RH TRU waste)³ <ul style="list-style-type: none"> - MEI – 1.6E-06 PCF - Population – 0.024 LCF - Non-involved workers – 1.3E-04 PCF • Earthquake⁴ <ul style="list-style-type: none"> - MEI – 1.6E-05 PCF - Population – 0.24 LCF - Non-involved workers – 1.4E-03 PCF • Vehicle impact/fire (CH TRU and RH TRU waste)⁵ <ul style="list-style-type: none"> - MEI – 1.4E-07 PCF - Population – 2.1E-03 LCF - Non-involved workers – 1.2E-05 PCF 	<ul style="list-style-type: none"> • MVSTs Breach¹ - NA • MVSTs transfer line failure² <ul style="list-style-type: none"> - MEI – 3.2E-06 PCF - Population – 0.16 LCF - Non-involved workers – 2.8E-04 PCF • Vehicle impact³ - negligible • Earthquake⁴ <ul style="list-style-type: none"> - MEI – 4.8E-07 PCF - Population – 7.2E-03 LCF - Non-involved workers – 4.2E-05 PCF • Vehicle impact/fire⁵ - negligible 	<ul style="list-style-type: none"> • Same as Low-Temperature Drying Alternative 	<ul style="list-style-type: none"> • MVSTs Breach¹ - NA • MVSTs transfer line failure² <ul style="list-style-type: none"> - MEI – 6.3E-06 PCF - Population – 0.31 LCF - Non-involved workers – 5.5E-04 PCF • Vehicle impact³ - negligible • Earthquake⁴ <ul style="list-style-type: none"> - MEI – 9.6E-07 PCF - Population – 0.014 LCF - Non-involved workers – 8.4E-05 PCF 	<ul style="list-style-type: none"> • MVSTs transfer line failure² <ul style="list-style-type: none"> - MEI – 3.2E-06 to 6.6E-06 PCF - Population – 0.16 to 0.31 LCF - Non-involved workers – 2.8E-04 to 5.5E-04 PCF • Vehicle impact³ - negligible • Earthquake (CH TRU and RH TRU waste)⁴ <ul style="list-style-type: none"> - MEI – 4.8E-07 to 9.6E-07 PCF - Population – 7.2E-03 to 1.4E-02 LCF - Non-involved workers – 4.2E-05 to 8.4E-05 PCF • Vehicle impact/fire (after processing)⁶ <ul style="list-style-type: none"> - MEI – 1.4E-07 PCF - Population – 2.1E-03 LCF - Non-involved workers – 1.2E-05 PCF

CH = contact-handled.
 LCFs = latent cancer fatalities.
 MEI = maximally exposed individual.
 MVSTs = Melton Valley Storage Tanks
 NA = not applicable.

ORNL = Oak Ridge National Laboratory
 PCF = probability of cancer fatality.
 RH = remote-handled.
 TRU = transuranic.

¹Melton Valley Storage Tanks (MVSTs) breach accident would be initiated by an earthquake with a 50,000-gal release to the environment.

²MVSTs transfer line failure accident assumes the line between the MVSTs and the treatment facility fails during waste transfer operations.

³Vehicle impact (CH TRU and RH TRU waste) accident assumes a forklift breaches a package of solid waste.

⁴Earthquake accident assumes that packages of solid waste fall causing the packages to breach.

⁵Vehicle impact/fire (CH TRU and RH TRU) accident assumes a vehicle accident resulting in breach of the waste package and an ignition of the vehicle fuel that results in burning of the wastes.

⁶Vehicle impact/fire (after processing) accident assumes a vehicle accident resulting in breach of the waste package and an ignition of the vehicle fuel that results in burning of the treated wastes (only applies following Low-Temperature Drying Alternative with assumed combustible macroencapsulant).

Table 2-6. Comparison of impacts among alternatives (continued)

	No Action Alternative	Low-Temperature Drying Alternative (Preferred)	Vitrification Alternative	Cementation Alternative	Treatment and Waste Storage at ORNL Alternative
Socioeconomic (Chapter 4, Section 4.13)	<ul style="list-style-type: none"> No change in economic activity 	<ul style="list-style-type: none"> No significant impacts Earnings represent 0.1% of the income for the region 	<ul style="list-style-type: none"> No significant impacts Earnings represent 0.2% of the income for the region 	<ul style="list-style-type: none"> No significant impacts Earnings represent 0.1% of the income for the region 	<ul style="list-style-type: none"> No significant impacts Earnings represent 0.1% of the income for the region
Environmental Justice (Chapter 4, Section 4.14)	<ul style="list-style-type: none"> No disproportionately high and adverse impact expected to minority and low-income populations 	<ul style="list-style-type: none"> No disproportionately high and adverse impact expected to minority and low-income populations 	<ul style="list-style-type: none"> No disproportionately high and adverse impact expected to minority and low-income populations 	<ul style="list-style-type: none"> No disproportionately high and adverse impact expected to minority and low-income populations 	<ul style="list-style-type: none"> No disproportionately high and adverse impact expected to minority and low-income populations

ORNL = Oak Ridge National Laboratory.

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